A13

MONITORING DEVICE

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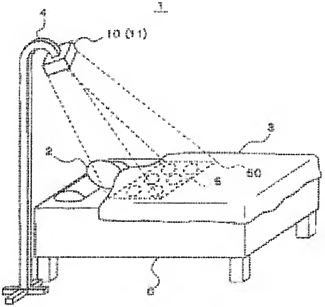
Abstract of **JP 2003088512 (A)**

PROBLEM TO BE SOLVED: To provide a monitoring device capable of not only surely detecting the state of a matter to be monitored but also being miniaturized and simplified. SOLUTION: This monitoring device 1 comprises two or more independent distance sensors 1 set toward different positions within a region 50 to be monitored to measure the distances to the matter to be monitored; an arithmetic unit 22 for arithmetically calculating the time change of the respective outputs of the distance sensors 11; and a detection processor 23 for detecting the shape change of the matter 2 on the basis of the calculated time change related to at least one selected distance sensor 11 of the distance sensors 11.



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(54)【発明の名称】監視装置

(57)【特許請求の範囲】

【請求項１】

監視対象領域内の異なる位置に向けて設置され、監視対象物までの距離を測定する、複数の各々独立した距離センサと；

前記複数の距離センサの各々の出力の時間変化を演算する演算装置と；

前記複数の距離センサの中から、過去の直近の一定時間における時間変化が最大の距離センサを選択し、前記選択された距離センサに対応する時間変化に基づいて、前記監視対象物の形状変化を検出する検出処理装置とを備え；

前記検出処理装置は、前記監視対象物の推移的変化を検出した場合には、該監視対象物が安静状態になってからの一定時間における時間変化が最大の距離センサを選択し、その時間変化に基づいて、前記監視対象物の形状変化を検出する；

監視装置。

【請求項２】

監視対象領域内の異なる位置に向けて設置され、監視対象物までの距離を測定する、複数の各々独立した距離センサと；

前記複数の距離センサの各々の出力の時間変化を演算する演算装置と；

前記複数の距離センサのうち一つ又は複数の選択された距離センサに関する前記演算された時間変化に基づいて前記監視対象物の形状変化を検出する検出処理装置とを備え；

前記検出処理装置は、前記複数の距離センサを全て選択し、前記選択された距離センサの出力の時間変化の総和を求め、該総和に基づいて、前記監視対象物の形状変化を検出す

るように構成された；

監視装置。

【請求項３】

監視対象領域内の異なる位置に向けて設置され、監視対象物までの距離を測定する、複数の各々独立した距離センサと；

前記複数の距離センサの各々の出力の時間変化を演算する演算装置と；

前記複数の距離センサのうち一つ又は複数の選択された距離センサに関する前記演算された時間変化に基づいて前記監視対象物の形状変化を検出する検出処理装置とを備え；

前記検出処理装置は、前記複数の距離センサの全ての出力の周波数スペクトルを算出して、前記算出された周波数スペクトルのピークの鋭さが一定値以上であり、且つ前記鋭さが最も高い距離センサを選択し、前記選択された距離センサに関する時間変化に基づいて、前記監視対象物の形状変化を検出するように構成された；

監視装置。

【請求項４】

監視対象領域内の異なる位置に向けて設置され、監視対象物までの距離を測定する、複数の各々独立した距離センサと；

前記複数の距離センサの各々の出力の時間変化を演算する演算装置と；

前記複数の距離センサのうち一つ又は複数の選択された距離センサに関する前記演算された時間変化に基づいて前記監視対象物の形状変化を検出する検出処理装置とを備え；

前記検出処理装置は、前記時間変化の絶対値が所定の幅にある距離センサの出力の周波数スペクトルを算出し、前記算出された周波数スペクトルのピークの鋭さが一定値以上であり、且つ前記鋭さが最も高い距離センサを選択し、前記選択された距離センサに関する時間変化に基づいて、前記監視対象物の形状変化を検出するように構成された；

監視装置。

【請求項５】

監視対象領域内の異なる位置に向けて設置され、監視対象物までの距離を測定する、複数の各々独立した距離センサと；

前記複数の距離センサの各々の出力の時間変化を演算する演算装置と；

前記複数の距離センサのうち一つ又は複数の選択された距離センサに関する前記演算された時間変化に基づいて前記監視対象物の形状変化を検出する検出処理装置とを備え；

前記検出処理装置は、前記時間変化の絶対値が大きい方から複数個の距離センサの出力の周波数スペクトルを算出し、前記算出された周波数スペクトルのピークの鋭さが一定値以上であり、且つ前記鋭さが最も高い距離センサを選択し、前記選択された距離センサに関する時間変化に基づいて、前記監視対象物の形状変化を検出するように構成された；

監視装置。

【請求項６】

監視対象領域内の異なる位置に向けて設置され、監視対象物までの距離を測定する、複数の各々独立した距離センサと；

前記複数の距離センサの各々の出力の時間変化を演算する演算装置と；

前記複数の距離センサのうち一つ又は複数の選択された距離センサに関する前記演算された時間変化に基づいて前記監視対象物の形状変化を検出する検出処理装置とを備え；

前記検出処理装置は、前記時間変化の絶対値が一定値を越える距離センサを選択し、前記選択された距離センサに関する時間変化の平均値に基づいて、前記監視対象物の形状変化を検出するように構成された；

監視装置。

【請求項７】

監視対象領域内の異なる位置に向けて設置され、監視対象物までの距離を測定する、複数の各々独立した距離センサと；

前記複数の距離センサの各々の出力の時間変化を演算する演算装置と；

前記複数の距離センサのうち一つ又は複数の選択された距離センサに関する前記演算さ

れた時間変化に基づいて前記監視対象物の形状変化を検出する検出処理装置とを備え；

前記検出処理装置は、前記時間変化の絶対値が一定値を越える距離センサを選択し、前記選択された距離センサに関する時間変化の絶対値の平均値に基づいて、前記監視対象物の形状変化を検出するように構成された；

監視装置。

【請求項８】

監視対象領域内の異なる位置に向けて設置され、監視対象物までの距離を測定する、複数の各々独立した距離センサと；

前記複数の距離センサの各々の出力の時間変化を演算する演算装置と；

前記複数の距離センサのうち一つ又は複数の選択された距離センサに関する前記演算された時間変化に基づいて前記監視対象物の形状変化を検出する検出処理装置とを備え；

前記検出処理装置は、前記複数の選択された距離センサに関する前記時間変化の各々の位相を互いに比較し、前記比較により前記位相が近いもの各々をグループ化して、前記各グループの時間変化の総和を求め、逆位相に近いグループ間で、前記各々のグループの前記総和を差算し、前記差算より得られた値に基づいて、前記監視対象物の形状変化を検出するように構成された；

監視装置。

【請求項９】

前記検出処理装置は、前記検出された形状変化中の周期的変化の周期及び振幅のいずれか一方又は両方に基づいて前記監視対象物の状態を判断するように構成された；

請求項１乃至請求項８のいずれか１項に記載の監視装置。

【請求項１０】

前記検出処理装置は、前記検出された形状変化中の周期的変化が一定時間以上継続したときに、前記監視対象物が前記監視対象領域内にあると判断するように構成された；

請求項１乃至請求項９のいずれか１項に記載の監視装置。

【請求項１１】

前記距離センサは、前記監視対象物に光束を照射する光照射手段と、該光照射手段により前記監視対象物上に生成される光照射パターンの像を結像する結像光学系とを有し、前記結像光学系により結像される結像パターン光の結像位置に基づいて、三角法により前記距離に対応する出力を得るように構成された；

請求項１乃至請求項１０のいずれか１項に記載の監視装置。

【請求項１２】

前記距離センサは、前記監視対象物を個別の光軸により結像する２以上の結像装置と、前記結像装置からの結像位置の情報に基づいて、三角法により前記距離に対応する出力を得るように構成された；

請求項１乃至請求項１０のいずれか１項に記載の監視装置。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】

本発明は、監視対象物を監視する監視装置に関し、特に就寝者の呼吸などの変化を監視するための監視装置に関するものである。

【０００２】

【従来の技術】

就寝者の呼吸の変化を監視する監視装置として、従来から、荷重センサまたは圧力センサにより検出した圧力分布の時間推移に基づき、就寝者の呼吸の変化を監視する装置が提案されている。

【０００３】

【発明が解決しようとする課題】

しかしながら以上のような従来の装置によれば、監視装置は、測定される信号が微小であることから、安定した信号を取得し検出するためには、高性能な信号増幅器やなんらかの

信号処理が必要であり、システムとして複雑かつ大掛かりなものになっていた。

【０００４】

そこで本発明は、監視対象物の状態を確実に検出するだけでなく、小型で、かつ単純である監視装置を提供することを目的としている。

【０００５】

【課題を解決するための手段】

上記目的を達成するために、請求項１に係る発明による監視装置は、例えば図１、図３に示すように、監視対象領域５０内の異なる位置に向けて設置され、監視対象物までの距離を測定する、複数の各々独立した距離センサ１１と；複数の距離センサ１１の各々の出力の時間変化を演算する演算装置２２と；複数の距離センサ１１の中から、過去の直近の一定時間における時間変化が最大の距離センサ１１を選択し、前記選択された距離センサ１１に対応する時間変化に基づいて、監視対象物２の形状変化を検出する検出処理装置２３とを備え；検出処理装置２３は、監視対象物２の推移的変化を検出した場合には、監視対象物２が安静状態になってから、直近の一定時間における時間変化が最大の距離センサ１１を選択し、その時間変化に基づいて、監視対象物２の形状変化を検出するように構成される。

【０００６】

このように構成すると、複数の各々独立した距離センサ１１と、複数の距離センサ１１の各々の出力の時間変化を演算する演算装置２２とを備えるので、例えば、監視対象物までの距離の時間変化を得ることができる。複数の距離センサ１１の中から、過去の直近の一定時間における時間変化が最大の距離センサ１１を選択し、前記選択された距離センサ１１に対応する時間変化に基づいて、監視対象物２の形状変化を検出して、監視対象物２の推移的変化を検出した場合には、監視対象物２が安静状態になってから、直近の一定時間における時間変化が最大の距離センサ１１を選択し、その時間変化に基づいて、監視対象物２の形状変化を検出するので、例えば、就寝者の呼吸を検出できる。これにより、就寝者の状態を確実に検出するだけでなく、小型で、かつ単純である監視装置を提供することができる。

【０００７】

上記目的を達成するために、請求項２に係る発明による監視装置は、例えば図１、図３に示すように、監視対象領域５０内の異なる位置に向けて設置され、監視対象物２までの距離を測定する、複数の各々独立した距離センサ１１と；複数の距離センサ１１の各々の出力の時間変化を演算する演算装置２２と；複数の距離センサ１１のうち一つ又は複数の選択された距離センサ１１に関する前記演算された時間変化に基づいて監視対象物２の形状変化を検出する検出処理装置２３とを備え；検出処理装置２３は、複数の距離センサ１１を全て選択し、前記選択された距離センサ１１の出力の時間変化の総和を求め、該総和に基づいて、前記監視対象物２の形状変化を検出するように構成される。

【０００８】

このように構成すると、複数の距離センサ１１と、演算装置２２と、検出処理装置２３とを備えているので、複数の距離センサ１１のうち一つ又は複数の選択された距離センサ１１に関する前記演算された時間変化に基づいて監視対象物２の形状変化を検出することができる。検出処理装置２３は、複数の距離センサ１１を全て選択し、前記選択された距離センサ１１の出力の時間変化の総和を求め、該総和に基づいて、前記監視対象物２の形状変化を検出するように構成されるので、例えば高速処理が可能である。これにより、就寝者の状態を確実に検出するだけでなく、小型で、かつ単純である監視装置を提供することができる。

【０００９】

上記目的を達成するために、請求項３に係る発明による監視装置は、例えば図１、図３に示すように、監視対象領域５０内の異なる位置に向けて設置され、監視対象物２までの距離を測定する、複数の各々独立した距離センサ１１と；複数の距離センサ１１の各々の出力の時間変化を演算する演算装置２２と；複数の距離センサ１１のうち一つ又は複数の選

択された距離センサ１１に関する前記演算された時間変化に基づいて監視対象物２の形状変化を検出する検出処理装置２３とを備え；検出処理装置２３は、複数の距離センサ１１の全ての出力の周波数スペクトルを算出して、前記算出された周波数スペクトルのピークの鋭さが一定値以上であり、且つ前記鋭さが最も高い距離センサ１１を選択し、前記選択された距離センサに関する時間変化に基づいて、監視対象物２の形状変化を検出するように構成される。

【００１０】

このように構成すると、複数の距離センサ１１と、演算装置２２と、検出処理装置２３とを備えているので、複数の距離センサ１１のうち一つ又は複数の選択された距離センサ１１に関する前記演算された時間変化に基づいて監視対象物２の形状変化を検出することができる。検出処理装置２３は、複数の距離センサ１１の全ての出力の周波数スペクトルを算出して、前記算出された周波数スペクトルのピークの鋭さが一定値以上であり、且つ前記鋭さが最も高い距離センサ１１を選択し、前記選択された距離センサに関する時間変化に基づいて、監視対象物２の形状変化を検出するように構成されるので、例えば就寝者の呼吸を確実に検出できる。これにより、就寝者の状態を確実に検出するだけでなく、小型で、かつ単純である監視装置を提供することができる。

【００１１】

上記目的を達成するために、請求項４に係る発明による監視装置は、例えば図１、図３に示すように、監視対象領域５０内の異なる位置に向けて設置され、監視対象物２までの距離を測定する、複数の各々独立した距離センサ１１と；複数の距離センサ１１の各々の出力の時間変化を演算する演算装置２２と；複数の距離センサ１１のうち一つ又は複数の選択された距離センサ１１に関する前記演算された時間変化に基づいて監視対象物２の形状変化を検出する検出処理装置２３とを備え；検出処理装置２３は、前記時間変化の絶対値が所定の幅にある距離センサ１１の出力の周波数スペクトルを算出し、前記算出された周波数スペクトルのピークの鋭さが一定値以上であり、且つ前記鋭さが最も高い距離センサ１１を選択し、前記選択された距離センサ１１に関する時間変化に基づいて、監視対象物２の形状変化を検出するように構成される。

【００１２】

このように構成すると、複数の距離センサ１１と、演算装置２２と、検出処理装置２３とを備えているので、複数の距離センサ１１のうち一つ又は複数の選択された距離センサ１１に関する前記演算された時間変化に基づいて監視対象物２の形状変化を検出することができる。検出処理装置２３は、前記時間変化の絶対値が所定の幅にある距離センサ１１の出力の周波数スペクトルを算出し、前記算出された周波数スペクトルのピークの鋭さが一定値以上であり、且つ前記鋭さが最も高い距離センサ１１を選択し、前記選択された距離センサ１１に関する時間変化に基づいて、監視対象物２の形状変化を検出するように構成されるので、例えば就寝者の呼吸を確実に検出できる。これにより、就寝者の状態を確実に検出するだけでなく、小型で、かつ単純である監視装置を提供することができる。

【００１３】

上記目的を達成するために、請求項５に係る発明による監視装置は、例えば図１、図３に示すように、監視対象領域５０内の異なる位置に向けて設置され、監視対象物２までの距離を測定する、複数の各々独立した距離センサ１１と；複数の距離センサ１１の各々の出力の時間変化を演算する演算装置２２と；複数の距離センサ１１のうち一つ又は複数の選択された距離センサ１１に関する前記演算された時間変化に基づいて監視対象物２の形状変化を検出する検出処理装置２３とを備え；検出処理装置２３は、前記時間変化の絶対値が大きい方から複数個の距離センサ１１の出力の周波数スペクトルを算出し、前記算出された周波数スペクトルのピークの鋭さが一定値以上であり、且つ前記鋭さが最も高い距離センサ１１を選択し、前記選択された距離センサ１１に関する時間変化に基づいて、監視対象物２の形状変化を検出するように構成される。

【００１４】

このように構成すると、複数の距離センサ１１と、演算装置２２と、検出処理装置２３と

を備えているので、複数の距離センサ１１のうち一つ又は複数の選択された距離センサ１１に関する前記演算された時間変化に基づいて監視対象物２の形状変化を検出することができる。検出処理装置２３は、前記時間変化の絶対値が大きい方から複数個の距離センサ１１の出力の周波数スペクトルを算出し、前記算出された周波数スペクトルのピークの鋭さが一定値以上であり、且つ前記鋭さが最も高い距離センサ１１を選択し、前記選択された距離センサ１１に関する時間変化に基づいて、監視対象物２の形状変化を検出するように構成されるので、例えば就寝者の呼吸を確実に検出できる。これにより、就寝者の状態を確実に検出するだけでなく、小型で、かつ単純である監視装置を提供することができる。

【００１５】

上記目的を達成するために、請求項６に係る発明による監視装置は、例えば図１、図３に示すように、監視対象領域５０内の異なる位置に向けて設置され、監視対象物２までの距離を測定する、複数の各々独立した距離センサ１１と；複数の距離センサ１１の各々の出力の時間変化を演算する演算装置２２と；複数の距離センサ１１のうち一つ又は複数の選択された距離センサ１１に関する前記演算された時間変化に基づいて監視対象物２の形状変化を検出する検出処理装置２３とを備え；検出処理装置２３は、前記時間変化の絶対値が一定値を越える距離センサ１１を選択し、前記選択された距離センサ１１に関する時間変化の平均値に基づいて、監視対象物２の形状変化を検出するように構成される。

【００１６】

このように構成すると、複数の距離センサ１１と、演算装置２２と、検出処理装置２３とを備えているので、複数の距離センサ１１のうち一つ又は複数の選択された距離センサ１１に関する前記演算された時間変化に基づいて監視対象物２の形状変化を検出することができる。検出処理装置２３は、時間変化の絶対値が一定値を越える距離センサを選択し、選択された距離センサに関する時間変化の平均値に基づいて、監視対象物２の形状変化を検出するように構成されるので、例えば就寝者の呼吸を確実に検出できる。これにより、就寝者の状態を確実に検出するだけでなく、小型で、かつ単純である監視装置を提供することができる。

【００１７】

上記目的を達成するために、請求項７に係る発明による監視装置は、例えば図１、図３に示すように、監視対象領域５０内の異なる位置に向けて設置され、監視対象物２までの距離を測定する、複数の各々独立した距離センサ１１と；複数の距離センサ１１の各々の出力の時間変化を演算する演算装置２２と；複数の距離センサ１１のうち一つ又は複数の選択された距離センサ１１に関する前記演算された時間変化に基づいて監視対象物２の形状変化を検出する検出処理装置２３とを備え；検出処理装置２３は、前記時間変化の絶対値が一定値を越える距離センサ１１を選択し、前記選択された距離センサ１１に関する時間変化の絶対値の平均値に基づいて、監視対象物２の形状変化を検出するように構成される。

【００１８】

このように構成すると、複数の距離センサ１１と、演算装置２２と、検出処理装置２３とを備えているので、複数の距離センサ１１のうち一つ又は複数の選択された距離センサ１１に関する前記演算された時間変化に基づいて監視対象物２の形状変化を検出することができる。検出処理装置２３は、時間変化の絶対値が一定値を越える距離センサを選択し、選択された距離センサに関する時間変化の絶対値の平均値に基づいて、監視対象物２の形状変化を検出するように構成されるので、例えば就寝者の呼吸を確実に検出できる。これにより、就寝者の状態を確実に検出するだけでなく、小型で、かつ単純である監視装置を提供することができる。

【００１９】

上記目的を達成するために、請求項８に係る発明による監視装置は、例えば図１、図３に示すように、監視対象領域５０内の異なる位置に向けて設置され、監視対象物までの距離を測定する、複数の各々独立した距離センサ１１と；複数の距離センサ１１の各々の出力

の時間変化を演算する演算装置２２と；複数の距離センサ１１のうち一つ又は複数の選択された距離センサ１１に関する前記演算された時間変化に基づいて監視対象物２の形状変化を検出する検出処理装置２３とを備え；検出処理装置２３は、前記複数の選択された距離センサ１１に関する前記時間変化の各々の位相を互いに比較し、前記比較により前記位相が近いもの各々をグループ化して、前記各グループの時間変化の総和を求め、逆位相に近いグループ間で、前記各々のグループの前記総和を差算し、前記差算より得られた値に基づいて、監視対象物２の形状変化を検出するように構成される。

【００２０】

このように構成すると、複数の距離センサ１１と、演算装置２２と、検出処理装置２３とを備えているので、複数の距離センサ１１のうち一つ又は複数の選択された距離センサ１１に関する前記演算された時間変化に基づいて監視対象物２の形状変化を検出することができる。検出処理装置２３は、前記複数の選択された距離センサ１１に関する前記時間変化の各々の位相を互いに比較し、前記比較により前記位相が近いもの各々をグループ化して、前記各グループの時間変化の総和を求め、逆位相に近いグループ間で、前記各々のグループの前記総和を差算し、前記差算より得られた値に基づいて、監視対象物２の形状変化を検出するように構成されるので、例えば就寝者の呼吸を確実に検出できる。これにより、就寝者の状態を確実に検出するだけでなく、小型で、かつ単純である監視装置を提供することができる。

【００２１】

また請求項９に記載のように、請求項１乃至請求項８のいずれか１項に記載の監視装置１では、検出処理装置２３は、前記検出された形状変化中の周期的変化の周期及び振幅のいずれか一方又は両方に基づいて監視対象物２の状態を判断するように構成するとよい。

【００２２】

また請求項１０に記載のように、請求項１乃至請求項９のいずれか１項に記載の監視装置１では、検出処理装置２３は、前記検出された形状変化中の周期的変化が一定時間以上継続したときに、監視対象物２が監視対象領域５０内にあると判断するように構成するとよい。

【００２３】

このように構成すると、前記検出された形状変化中の周期的変化が一定時間以上継続したときに、監視対象物２が監視対象領域５０内にあると判断するように構成されているので、例えば就寝者の在床を検出できる。

【００２４】

また、以上の監視装置１では、検出処理装置２３は、前記検出された形状変化中の推移的変化を検出した後に、周期的変化を検出することがなく、一定時間以上、推移的変化及び周期的変化を共に検出できない状態になったとき、監視対象物２が監視対象領域５０の外に出たと判断するように構成するとよい。このように構成すると、例えば就寝者の離床を判断できる。

【００２５】

また請求項１１に記載のように、請求項１乃至請求項１０のいずれか１項に記載の監視装置１では、例えば図５に示すように、距離センサ３０は、監視対象物２に光束を照射する光照射手段３１と、光照射手段３１により監視対象物２上に生成される光照射パターンの像を結像する結像光学系３７とを有し、結像光学系３７により結像される結像パターン光の結像位置に基づいて、三角法により前記距離に対応する出力を得るように構成するとよい。

【００２６】

このように構成すると、距離センサ３０は、監視対象物２に光束を照射する光照射手段３１と、光照射手段３１により監視対象物２上に生成される光照射パターンの像を結像する結像光学系３７とを有し、結像光学系３７により結像される結像パターン光の結像位置に基づいて、三角法により前記距離に対応する出力を得るように構成されているので、安価で単純な監視装置１とすることができる。

【００２７】
また請求項１２に記載のように、請求項１乃至請求項１０のいずれか１項に記載の監視装置１では、例えば図１０に示すように、距離センサ４０は、監視対象物２を個別の光軸により結像する２以上の結像装置４１、４２と、結像装置４１、４２からの結像位置の情報に基づいて、三角法により前記距離に対応する出力を得るように構成してもよい。
【００２８】
このように構成すると、距離センサ４０は、監視対象物２を個別の光軸により結像する２以上の結像装置４１、４２と、結像装置４１、４２からの結像位置の情報に基づいて、三角法により前記距離に対応する出力を得るように構成されているので、安価で単純な監視装置１とすることができる。
【００２９】
上記目的を達成するために、本発明による監視装置は、例えば図１、図３に示すように、監視対象領域５０内に向けて設置され、監視対象物２までの距離を測定する距離センサ１１と；距離センサ１１の出力の時間変化を演算する演算装置２２と；前記演算された時間変化に基づいて監視対象物２の形状変化を検出する検出処理装置２３とを備え；検出処理装置２３は、前記検出された形状変化中の周期的変化が一定時間以上継続したときに、監視対象物２が監視対象領域５０内にあると判断するように構成されていてもよい。
【００３０】
このように構成すると、距離センサ１１と、演算装置２２と、検出処理装置２３とを備えているので、距離センサ１１の出力の時間変化を演算し、前記演算された時間変化に基づいて監視対象物２の形状変化を検出することができる。検出処理装置２３は、前記検出された形状変化中の周期的変化が一定時間以上継続したときに、監視対象物２が監視対象領域５０内にあると判断するように構成されるので、例えば就寝者の呼吸や在床を検出できる。また、単純に構成できる。これにより、就寝者の状態を確実に検出するだけでなく、小型で、かつ単純である監視装置を提供することができる。
【００３１】
【発明の実施の形態】
以下、本発明の実施の形態について、図面を参照して説明する。なお、各図において互いに同一あるいは相当する部材には同一符号または類似符号を付し、重複した説明は省略する。
【００３２】
図１は、本発明による実施の形態である監視装置１の模式的斜視図である。図中監視対象領域としてのベッド６上面（以下監視領域５０という）に監視対象物であり周期的変化をする物としての就寝者２が横たわって存在している。また、就寝者２の上には、さらに寝具３がかけられており、就寝者２の一部と、ベッド６の一部とを覆っている。即ち監視装置１は、寝具３の上面を監視している。また寝具３を使用せず、監視装置１は、就寝者２の胴体部そのものを監視するようにしてもよい。また、本実施の形態では、形状変化は、連続的変化であり、連続的変化は周期的変化、推移的変化を含む概念である。就寝者２の形状変化は、例えば、就寝者２の周期的変化及び推移的変化である。また就寝者２の周期的変化は、例えば就寝者２の呼吸である。就寝者２の推移的変化は、例えば就寝者２の体動、移動である。また、周期的変化とは、例えば人物（就寝者）の呼吸の周期、例えば、毎分５～６０サイクルの変化である。即ち本実施の形態では、周期的変化は、呼吸の周期から大きく外れた周期的変化を含まない。ところで、大人の呼吸数は、毎分５～３０回程度の範囲にあるが、幼児の場合にはさらに呼吸数が多くなる傾向がある。
【００３３】
さらに、監視装置１は、検出された就寝者２の形状変化に基づいて、就寝者２の状態を判断するように構成される。就寝者２の状態とは、例えば正常な呼吸をしている、異常な呼吸をしており危険である、体動例えば寝返りを打っている、移動例えば着床、離床しようとしている等といった状態である。
【００３４】

一方、図中スタンド４には、監視領域５０内に存在する就寝者２までの距離を測定する複数の距離センサ１１を含んで構成される筐体１０が設置されている。筐体１０には、複数の距離センサ１１が、複数の監視対象点（以下対象点という）に対応して設置されている。また本実施の形態では、筐体１０（距離センサ１１）は、スタンド４に設置しているが、壁や天井が存在する場合は、壁や天井でもよく、設置場所は監視装置の目的や仕様等により適宜決めてよい。またスタンド４は、移動可能であり、筐体１０の設置を容易にしている。距離センサ１１は、筐体１０に２列以上配置することが好ましい。

【００３５】

図２の模式的平面図の対象点の配置例を参照して、又適宜図１を参照して、対象点について説明する。図２（ａ）に示すように、複数の距離センサ１１に対応する複数の対象点は、それぞれの対象点が隣合う対象点と重ならないように配置する。この場合、例えば図示のように、複数の対象点は、監視領域５０に、対象点５１、５２、５３、５４、５５、５６（以下対象点を区別しない場合は単に対象点５という）が、お互いに重ならないように碁盤目状に配置されている。複数の対象点５は、ベッド６上（寝具３下）の就寝者２のおよそ腹部、胸部、背部、および肩部が就寝中に取り得る位置を網羅する範囲に設定することが好ましい。配置する数は、本実施の形態では、３行２列（以下３×２と表す）であるが、監視する場所、就寝者２などの条件により適宜決めてよく、例えば３×３、４×４でもよい。このように複数の対象点５を配置すると、距離センサ１１に、光や超音波を照射することにより距離を測定する照射型センサを使用した場合でも、隣接する対象点５に対応する距離センサ１１は、後述のように同時に照射しないように制御する必要がなく、監視装置１をより簡単な構成とすることができる。

【００３６】

また図２（ｂ）の模式的平面図の対象点５の配置例に示すように、隣合う対象点５が重なっていてもよい。このようにすると、監視領域５０内の死角を少なくすることができるので、より精度の高い監視に有効である。このとき距離センサ１１に、光や超音波を照射することにより距離を測定する照射型センサを使用する場合には、重なり合う対象点５に対応する距離センサ１１は、お互いに影響がないように、同時に照射しないように制御する必要がある。これは、複数の距離センサ１１から同時に例えば照射光を照射した場合、本来受光しなければならない照射光に他の距離センサ１１から照射された照射光が混入し、対象点５の距離の測定が困難になるためである。

【００３７】

また、距離センサ１１に例えば後述の赤外線距離センサ３０（図５参照）を用いた場合には、赤外線距離センサ３０を、後述のように投光する光束の波長をセンサ毎に異なるようにし、併せて、コーティングを施す等の手段により後述の受光レンズ３７に投光するビーム光に対応した透過波長帯域を通過させるようにした場合には、隣合う対象点５が重なっていても同時に照射しないように制御する必要がない。また、距離センサ１１を、照射する光束の光源を、各距離センサ３０毎に異なる一定の周波数で点滅させ、併せて、その周波数の信号のみを抽出する後述の電気的バンドパスフィルタを備えるようにした場合には、隣合う対象点５が重なっていても同時に照射しないように制御する必要がない。

【００３８】

ここで、図２（ｂ）に示すように、距離センサ１１に照射型センサを使用し、かつ複数の距離センサ１１に対応する対象点５が重複する場合の作動の制御について説明する。この制御は、後述の制御装置２０の制御部２１で行なうようにする。照射型センサの場合には、１つの距離センサ１１の距離の測定の後で、次の距離センサ１１の距離の測定を行うように制御する。即ち複数の距離センサ１１が同時に距離の測定をしないように制御する。このような動作が、備えられた全ての距離センサ１１の距離の測定が行われるまで繰り返される。この一連の動作を１サイクルとし、１サイクルの時間をＴとする。

【００３９】

また、上述のように１つずつ距離センサ１１による距離の測定を行うのではなく、隣接する対象点５の距離の測定を同時に行わないように制御する（例えば同時に距離の測定を行

なう対象点５を１つおきとする）ことで、複数の距離センサ１１に同時に距離の測定を行わせることができる。このようにすれば、１サイクルの時間Ｔを大幅に短縮できる。
【００４０】
図３を参照して、監視装置１の構成の一例を説明する。監視装置１は、複数の距離センサ１１が設置された筐体１０と、制御装置２０とを含んで構成される。制御装置２０は、典型的にはパソコンやマイコンである。そして複数の距離センサ１１は、制御装置２０に接続されており、距離センサ１１の出力としての距離情報を制御装置２０に出力するように構成されている。ここで、距離情報とは、例えば実際に距離を算出する前の距離センサ１１からの出力値であるが、対象物（就寝者２）までの距離そのものとしてもよい。以下、これらを単に距離という。以下、距離で実施の形態を説明する。また距離は、それぞれの距離センサ１１から時系列的に取得するように構成するとよい。また、図中距離センサ１１と制御装置２０とは、別体として示してあるが、一体として構成してもよい。
【００４１】
また距離センサ１１は、本実施の形態では、図２で説明したように３×２に配置された対象点５に対応するように、筐体１０に３×２に設置されている。
【００４２】
また典型的には、距離センサ１１は筐体１０に並列的に設置されるが、図４の模式図に示す筐体１０’ように、筐体１０にカーブをつけてもよい。この場合、距離センサ１１は、このカーブに沿うように設置する。このような筐体１０’を用いることで、小型化しても広い監視領域５０を容易に確保することができる。また、筐体１０’は、小型でも、隣合う対象点５が重ならないように距離センサ１１を設置することが容易に行なえるので、装置の小型化を図ることができる。
【００４３】
ここで、距離センサ１１についてさらに説明する。使用する距離センサ１１としては、赤外線照射型の距離センサ、超音波センサ、電磁波パルス距離センサ、パッシブ型光学距離センサ等がある。このうち赤外線照射型の距離センサ、超音波センサ、電磁波パルス距離センサは照射型センサ（アクティブ型距離センサ）である。また使用する距離センサ１１は、上記のように、例えばオートフォーカスカメラに用いるような比較的単純で安価なものを用いることが好ましい。このような距離センサ１１を用いることで、監視装置１を単純で安価に構成できる。以下、距離センサ１１の実施例としての赤外線距離センサ、超音波センサ、電磁波パルス距離センサ、パッシブ型光学距離センサについて図を参照して説明する。
【００４４】
図５のブロック図を参照して、距離センサ１１の実施例としての赤外線照射型の距離センサ３０（以下赤外線距離センサ３０という）について説明する。赤外線距離センサ３０は、いわゆるアクティブ型光学センサである。赤外線距離センサ３０は、就寝者２に光束を照射する光照射手段としての赤外光照射部３１、赤外光受光部３２ｂ、赤外線距離センサ３０全体を制御するセンサ制御部３３を含んで構成されている。またセンサ制御部３３は、制御装置２０の制御部２１内（図３参照）に備えるようにしてもよい。
【００４５】
赤外光照射部３１には、赤外ＬＥＤ３４と照射レンズ３５とが備えられており、赤外ＬＥＤ３４から照射された赤外光の光束は照射レンズ３５を介して細い平行光束のビーム光として就寝者２に照射される。ここで平行光束とは、実質的に平行であればよく、平行に近い光束も含む。赤外光受光部３２は、赤外光照射部３１により就寝者２上に生成される光照射パターンの像を結像する結像光学系としての受光レンズ３７と、受光レンズ３７による結像位置近傍に配置され、結像した光照射パターンの像による結像パターン光を受光する受光手段としての１次元の位置検出素子３６（以下ＰＳＤ３６という）とを有している。
【００４６】
さらに、赤外線距離センサ３０は、ＰＳＤ３６上に結像される結像パターン光の結像位置

に基づいて、就寝者２までの距離に対応する結像パターンの結像位置情報を出力するように構成された位置情報出力装置としての位置情報出力部３９を有している。位置情報出力部３９は、センサ制御部３３内に備えられている。即ち、受光レンズ３７により結像される結像パターン光の結像位置に基づいて、三角法により前記距離に対応する出力としての結像パターンの結像位置情報を得るように構成されている。ここでは、光束は例えばビーム光であり、光束による光照射パターンはビーム光スポットである。そして結像パターン光は、就寝者２上に生成されたビーム光スポットの就寝者２からの反射光の内、ＰＳＤ３６に入射する光であり、結像パターンは、受光レンズ３７により結像された就寝者２上に生成されたビーム光スポットの像である。即ちここでは結像パターンは、略円形の像である。

【００４７】

受光レンズ３７は、照射されたビーム光の波長帯域の光のみを透過させるコーティングが施されている。従って、外乱光の影響が少なく位置検出をすることができる。また以上では光束は細い平行光束としたが、これは実質的に平行光束であればよく、ある程度拡散あるいは収束した光束であってもよい。この場合は、後述のＰＳＤ３６上のパターン光の大きさが適当であって、重心位置の補足に差支えない程度であればよい。

【００４８】

さらに、赤外線距離センサ３０は、赤外光照射部３１が投光するビーム光の波長をセンサ毎に異なるようにしてもよい。この場合には、併せて、前述の受光レンズ３７に施されたコーティングの透過波長帯域も、投光するビーム光に対応した透過波長帯域になるようにする。これにより、図２（ｂ）で説明した隣合うビーム光が重なる場合であっても、隣のセンサのビーム光の影響を受けることが無く、同時に照射しないように制御する必要がないので監視装置を単純化できる。また赤外線距離センサ３０は、赤外ＬＥＤ３４（光源）を一定の周波数で点滅させ、赤外光受光部３２にその周波数の信号のみを抽出する電気的バンドパスフィルタを備えるようにしてもよい。これにより、外乱光の影響を低減することができる。また、この変調周波数をセンサ毎に変えることにより、図２（ｂ）で説明したビーム光が重なる場合でも隣のセンサのビーム光の影響を受けることが無くなる。これにより、ビーム光が重なる場合であっても同時に照射しないように制御する必要がなく監視装置を単純化できる。さらに、赤外ＬＥＤ３４の照射のタイミングに同期させて赤外光受光部３２のアンプの極性を切換える同期検波を行っても好適である。

【００４９】

図６を参照して、ＰＳＤ３６についてさらに説明する。図６（ａ）は、模式的平面図であり、図６（ｂ）は、模式的正面断面図である。図６（ａ）に示すように、ＰＳＤ３６は、結像パターンよりも大きい受光面積を有しており、また距離変化による結像パターンの移動方向（図中左右方向）に、必要な測距範囲内で、結像パターンの移動により結像パターンがはみ出さない程度の長さを有している。

【００５０】

また図６（ｂ）に示すように、ＰＳＤ３６は、平板状のシリコンの結像パターン光を受光する側の表面にＰ層３６ａ、Ｐ層３６ａと反対側の表面にＮ層３６ｂ、そしてＰ層３６ａとＮ層３６ｂとの中間にあるＩ層３６ｃから構成されている。ＰＳＤ３６に結像された結像パターンは、光電に変換され、光電流としてＰ層３６ａの両端に付けられた電極３６ｄからそれぞれ分割出力されるように構成されている。

【００５１】

赤外線距離センサ３０は、ＰＳＤ３６の両端から出力される光電流の出力信号を位置情報出力部３９により演算することにより結像パターンの結像位置情報として結像パターンの重心位置を出力するので、後述のように、就寝者２までの距離を測定することができる。また、赤外線距離センサ３０は、照射するビーム光に、赤外線を用いることで、人間には見えず、不快感を与えることがない。

【００５２】

赤外線距離センサ３０のセンサ制御部３３は、ＰＳＤ３６により結像パターンの重心位置

を検出する際に、外乱光と区別するために、変調を行う。変調は、例えば周期的にビーム光の発光（照射）停止を繰り返し行なうような動作である。この場合、ビーム光の発光停止は、例えば光源を発光停止してもよいし、遮光板やスリットを回転させることにより、発光停止をするようにしてもよい。さらに変調は、上述に加え、外乱光の強さにより、ビーム光の出力も変化させるようにしてもよい。そしてセンサ制御部３３は、ビーム光を照射している時のＰＳＤ３６の出力値からビーム光を照射していない時のＰＳＤ３６の出力値を差し引いた出力値を算出する。またセンサ制御部３３は、信頼性を確保するために、変調動作を複数回行ない、その平均出力値を結像パターンの結像位置情報である重心補足信号（以下測距信号という）とする。センサ制御部３３は、測距信号の値である測距信号値ｘを距離として制御装置２０へ出力する。

【００５３】

図７の模式図に示すように、対象とする就寝者２までの距離値Ａは、この測距信号値ｘに基づいて、三角法を用いて次式で算出することができる。

$$A = f \times w / (x - b) \quad \cdots\cdots\cdots (1)$$

ｆは、赤外光受光部３２の受光レンズ３７を単一レンズとしたときそのレンズの焦点距離、ｗは、赤外ＬＥＤ３４とＰＳＤ３６との間の距離、言い換えれば、照射レンズ３５と受光レンズ３７の光軸間の距離（基線長）、ｂはＰＳＤ３６の受光素子の配置に依存するバイアス値を示す。またここでの焦点距離は、一般に用いられている組み合わせレンズを使用する場合は、その組み合わせレンズの焦点距離とする。上述のような距離値Ａを算出する場合には、制御装置２０の制御部２１により距離値Ａの算出を行うとよい。

【００５４】

また以上では、赤外線距離センサ３０は、距離として測距信号値ｘを出力する場合について説明したが、距離として上述の方法で算出された距離値Ａそのものを出力するように構成してもよい。

【００５５】

各々の赤外線距離センサ３０から出力される測距信号値ｘは、前述のように変調されているが、それでも僅かに外乱光の影響が残っており、変動をしている。この変動を吸収するために、時系列的に取得した測距信号値ｘを平均して、その時点のデータとする。このデータは、測距信号値ｘから算出した距離値Ａの平均値でもよいし、後で説明する距離値Ａから算出した高さＨ１の平均値である高さＨ２や奥行Ｌ１の平均値である奥行Ｌ２でもよい。平均のとり方は、色々と考えられるが、予め一定の時間間隔を定め、その間のデータを平均化してもよいし、予め、平均化する個数を定め、時系列的に移動平均値を算出する方法でもよい。前者の場合には、データ数が少なくて済み、大まかな状態把握に適する。後者の場合には、データ数は多少多くなるが、細かい挙動を追うことができる。

【００５６】

このように、赤外線距離センサ３０は、ＰＳＤ３６を用いることで、単純に構成できるので、安価で、単純な監視装置とすることができる。

【００５７】

図８のブロック図を参照して、本発明の実施の形態における超音波センサ７０について説明する。超音波センサ７０は、超音波発振器としての超音波送信部７１、超音波受信器としての超音波受信部７２、センサ制御部７３を含んで構成されている。さらにセンサ制御部７３内には、超音波送信部７１の送信と超音波受信部７２の受信の時間差で就寝者２までの距離を算出する距離算出部７４が備えられている。またセンサ制御部７３は、制御装置２０の制御部２１内に備えるようにしてもよい。また、超音波送信部７１と超音波受信部７２とは、本実施の形態では別体としたが、一体であってもよい。さらに、距離算出部７４で算出される就寝者２までの距離は、時間差そのものとしてもよい。これは、就寝者２までの距離が時間差から線形的に求められるため、時間差の変化をそのまま距離の変化と見ることができるからである。

【００５８】

超音波送信部７１で超音波を発生する手段は、圧電セラミックス等の圧電効果を有する材

料を金属板等で保持（振動子）し、信号電圧を印加することにより振動子が屈曲振動することにより超音波を発生させる。超音波受信部７２で受信する手段は、反射してきた超音波が振動子を振動させることにより電気出力を得るものである。従って、超音波距離センサの場合には、断続的に超音波を発生させて、反射して戻ってきた信号波を検出し、発信側と受信側とで時間差を検出することができれば、音速が分かっているので就寝者２までの距離を測定することができる。この場合、検出後の信号処理にもよるが、最も近い反射を検出したり、照射領域の平均的な距離を測定することができる。

【００５９】

図９のブロック図を参照して、本発明の実施の形態における電磁波パルス距離センサ８０について説明する。電磁波パルス距離センサ８０は、電磁波送受信部８１とセンサ制御部８２とを含んで構成されている。電磁波送受信部８１は、アンテナを含んで構成され、就寝者２に向けてパルス変調された電磁波の発振と、就寝者２で反射された電磁波の受信とを行う。さらにセンサ制御部８２内には、電磁波の発振と受信との時間差で就寝者２までの距離を算出する距離算出部８３が備えられている。またセンサ制御部８２は、制御装置２０の制御部２１内に備えるようにしてもよい。また、電磁波送受信部８１は、本実施の形態では一体としたが、電磁波パルス送信部と電磁波受信部とを別体に構成してもよい。また、前述の超音波センサ７０と同様に就寝者2までの距離は、時間差そのものとしてもよい。電磁波は、典型的には１０ＧＨｚ程度のマイクロ波である。

【００６０】

電磁波パルス距離センサ８０は、電磁波にマイクロ波を用いることで、超音波よりも指向性が強くなるので、対象点5をよりピンポイントで測定することができる。また、電磁波パルス距離センサ８０は、対象物に照射された部位からの反射があれば、反射した電磁波のうち最短の時間で戻ってきたものから距離を測定するので、例えば赤外線距離センサのように、ＰＳＤ上の結像ビーム光が欠けることによる誤測距を起こすことがない。また電磁波パルス距離センサ８０は、照射領域内に強いコントラスト（例えば縞模様）があっても、赤外線距離センサのように影響されることがない。さらに、電磁波パルス距離センサ８０は、容易に小型化することが可能である。

以上の赤外線距離センサ３０、超音波センサ７０、電磁波パルス距離センサ８０は照射型センサである。

【００６１】

図１０のブロック図を参照して、本発明の実施の形態におけるパッシブ型光学距離センサ４０について説明する。パッシブ型光学距離センサ４０は、就寝者２からの光を受光する結像装置としての第1の受光部４１、第２の受光部４２、センサ制御部４３を含んで構成されている。第１の受光部４１、第２の受光部４２には、それぞれ受光レンズ４４ａ、４４ｂと、１対の撮像素子としての第１のラインＣＣＤ４５、第２のラインＣＣＤ４６とが備えられており、就寝者２からの光は、受光レンズ４４ａ、４４ｂを介してそれぞれ第1のラインＣＣＤ４５、第２のラインＣＣＤ４６に結像される。また、就寝者２からの光は、典型的には就寝者２に照射されている照射光の就寝者２からの反射光である。この場合、照射光は自然光であっても人工光であってもよい。

【００６２】

また、図１１に示すように、パッシブ型光学距離センサ４０は、不図示の照明パターン投光手段により監視領域５０に対して、特定の強度パターンをもつ照明光を照射するようにしてもよい。この場合、照明パターンは、後述の相関ピーク位置が複数出てしまうため、明確な周期的構造をさける。即ち非周期的照明パターンを用いるとよい。非周期的照明パターンは、例えば図１１（ａ）のように、非周期的な複数の輝点とするとよい。さらに、輝点は、それぞれの大きさを変えるようにしてもよい。また、図１１（ｂ）のように、非周期的な単数もしくは複数のスリット光としてもよい。さらに、スリット光は、それぞれの幅を変えるようにしてもよい。この場合、図示のようにスリット光が、距離センサ１１の基線方向におよそ垂直になるようにするとよい。このようにすることで、パッシブ型光学距離センサ４０は、対象点５内のコントラストが低かったり、対象点５内の対象物が周

期構造（例えば縞模様など）を持っている場合にも、後述の相関処理が不正確になるのを防ぐことができ、正確な測定が可能である。

【００６３】

また、センサ制御部４３内には、第１のラインＣＣＤ４５、第２のラインＣＣＤ４６のそれぞれの出力値の相関出力値を算出する相関出力算出装置としての相関出力算出部４８が備えられている。またセンサ制御部４３は、制御装置２０の制御部２１内に備えるようにしてもよい。さらにセンサ制御部４３内には、第１のラインＣＣＤ４５、第２のラインＣＣＤ４６のそれぞれについて時間をずらして取得された画像の差画像を形成する差画像形成装置としての差画像形成部４７を備えるとよい。これによりセンサ制御部４３は、第１のラインＣＣＤ４５、第２のラインＣＣＤ４６から取得した画像から、動きのある就寝者２の像を抽出することができる。差画像を形成するための２つの画像は時間をずらして取得するが、ずらす時間は、就寝者２の移動量が大きくなり過ぎず、実質的にはほぼ同位置とみなせる程度の時間、例えば０．１秒程度とすればよい。あるいはテレビ周期の１～１０周期（１／３０～１／３）とする。このような差画像をとると背景が除去され動きのある就寝者２の像を抽出することができる。差画像を利用する場合については後でさらに詳しく説明する。

【００６４】

ここで相関出力値とは、第１のラインＣＣＤ４５と第２のラインＣＣＤ４６との視差により発生する相対的結像位置差のことであり、相関処理により、典型的には画素数で出力される値である。センサ制御部４３は、この相関出力値により即ち第１のラインＣＣＤ４５と第２のラインＣＣＤ４６との視差から三角法により距離を算出する。また、相関処理とは、第１のラインＣＣＤ４５と第２のラインＣＣＤ４６からそれぞれ得られた画像のどちらか一方を、２つの画像がほぼ一致するまでずらして、そのずらした量例えば画素数を算出する処理である。一致の判断は、全体の信号の強さで行う。信号がピークなったところが一致点即ち相関ピーク位置である。差画像形成による相関処理は、第１のラインＣＣＤ４５と第２のラインＣＣＤ４６からそれぞれ得られた差画像を適正な値で２値化し、そのエッジ部を抽出する事により、動きのある領域部分を抽出する。その後、抽出領域のみで相関処理を施す。即ち、相関出力値から就寝者２の距離を求めることができる。又、第１のラインＣＣＤ４５と第２のラインＣＣＤ４６を複数個の領域に分け、対応する領域毎で相関処理を施す事により、背景の多くある部分と対象物とをおよそ区分する事もできる。

【００６５】

パッシブ型光学距離センサ４０は、オートフォーカスカメラに採用されているようなタイプのもので、典型的には１対のラインＣＣＤを用いて、就寝者２の表面の明暗状態（コントラストの違い）を検出する。１対のラインＣＣＤの対応する画素がどれかを相関処理により同定し、三角法により距離を測定するものである。パッシブ型光学距離センサ４０に一般的に用いられるラインＣＣＤは、画角が全角で１０°程度と狭く、対象点５をカバーするためには、比較的多くのセンサを必要とするが、照射型センサではないので、複数個のセンサからの出力を同時に作動させても全く問題ない。従って、高速に処理することができる。また、赤外線距離センサに比較すると、１対のラインＣＣＤ上での相対的位置の比較を行なっているので、中途半端にビームが欠けることによる影響もなく、対象点５の距離を安定して取得することができる利点がある。

【００６６】

ここで、パッシブ型光学距離センサ４０で、対象点５での就寝者２と背景との区別を明確にするための、差画像を利用する場合を詳しく説明する。

【００６７】

対象点５を撮像した画像は、電気的な撮像信号として第１のラインＣＣＤ４５、第２のラインＣＣＤ４６から時系列的に取得される。第１のラインＣＣＤ４５、第２のラインＣＣＤ４６から異なる時間に取得された画像は、それぞれのラインＣＣＤごとに差画像形成部４７により差画像が形成される。ここで、異なる時間で取得された画像で差画像を形成するのは、取得された画像から背景部分を除去し、就寝者２の画像を抽出するためである。

これにより、移動する就寝者２のみが抽出されることになる。また差画像は、短時間例えば０．１秒だけずれた時点の画像から形成するようにする。画像のずれは僅かであるので、就寝者２の位置はほとんど変わらなく、距離の測定には差支えない。しかし背景は消去され就寝者２の像を抽出できる。
【００６８】
就寝者２が抽出された差画像は、就寝者２の移動により明から暗、または、暗から明になった程度が比較的大きな画素を、就寝者２の境界とみなすことができる。そしてこの境界の内側の画素領域で、相関処理を施し、三角法により就寝者２の距離を測定することにより、就寝者２の距離を正確かつ安定して測定することができる。
【００６９】
ここで、図１２を参照して、パッシブ型光学距離センサ５０を使用しての対象点５までの距離Ａの算出方法について説明する。ここで、ｗはラインＣＣＤ間距離（基線長）、ｆはラインＣＣＤの受光レンズを単一レンズとしたときそのレンズの焦点距離、ｄはラインＣＣＤの結像面上の視差である。ここでの焦点距離は、一般に用いられている組み合わせレンズを使用する場合は、その組み合わせレンズの焦点距離とする。これにより対象点５までの距離Ａは、次式で算出できる。
$A = w \times f / d$ ………（２）
【００７０】
以上のように、監視装置１の距離センサ１１として、上述のいずれの距離センサを用いても、就寝者２の距離を取得できる。即ち就寝者２の距離を測定できる。
【００７１】
図３に戻って、さらに監視装置１を説明する。制御装置２０は、制御部２１を備えており、監視装置１全体を制御している。また複数の距離センサ１１は制御部２１に接続され、制御されている。制御部２１には、記憶部２４が接続されており、算出された情報等のデータが記憶できる。記憶部２４内には、距離センサ１１から出力された距離を時系列で保存する距離情報保存部２５が備えられている。また、距離情報保存部２５内には、就寝者２がベッド６上に存在していないときの対象点５までの距離である基準距離を保存するとよい。基準距離は、距離センサ１１から出力される距離と同じ形態で保存されている。ここでの距離情報保存部２５に時系列的に保存された距離は、監視時点の過去の時点の距離であればよく、例えば１コマ分だけ前に取得された距離であってもよい。
【００７２】
さらに記憶部２４内には、就寝者２の正常な呼吸パターン及び異常な呼吸パターンを保存する呼吸パターン保存部２６が備えられている。正常な呼吸パターン及び異常な呼吸パターンについては、図１４参照して後で説明する。
【００７３】
また制御部２１には、監視装置１を操作するための情報を入力する入力装置２７、監視装置１で処理された結果を出力する出力装置２８が接続されている。入力装置２７は例えばタッチパネル、キーボードあるいはマウスであり、出力装置２８は例えばディスプレイやプリンタである。本図では、入力装置２７、出力装置２８は制御装置２０に外付けするものとして図示されているが、内蔵されていてもよい。また、入力装置２７は、例えば監視の開始や解除を行なえるスイッチ、出力装置２８は、例えば動作インジケータとしてのＬＥＤとしてもよい。このようにすると、監視装置１を単純に構成できる。
【００７４】
また制御部２１には、外部と通信するためのインターフェイス２９が備えられている。インターフェイス２９は、例えば制御部２１の検出処理部２３により就寝者２が危険な状態にあると判断された場合に外部に通報することができるように構成されている。通報は、例えば音声、文字、記号、室内照明を含む光の強弱又は、振動などによるものである。またインターフェイス２９は、一般電話回線、ＩＳＤＮ回線、ＰＨＳ回線、または、携帯電話回線などの通信回線に対して接続する機能を備えている。また制御部２１は、音声出力機能を備えるようにし、インターフェイス２９を介して、第三者に就寝者が危険な状態に

あることを音声で通報するようにしてもよい。
【００７５】
さらに、制御部２１には、監視装置１に異常が発生した場合に作動するように構成された警報装置９０を有する。警報装置９０は、例えば検出処理部２３により就寝者２が危険な状態にあると判断された場合即ち就寝者２に異常が発生した場合や、監視装置１の故障等の異常が発生した場合に作動するように構成するとよい。このようにすることで、就寝者２に発生した異常に対して迅速に対応できるので、信頼性を高めることができる。制御装置２０は、警報装置９０が作動した場合に、インターフェイス２９を介して、前述のように異常の発生を外部に通報するように構成するとよい。本図では、警報装置９０は、外付けとして図示してあるが内蔵としてもよい。
【００７６】
また制御部２１内には、複数の距離センサ１１から出力される距離の時間変化を演算する演算装置としての演算部２２を備えている。複数の距離センサ１１から出力される距離は、過去一定回数取得した、または過去一定期間内に取得した距離の移動平均値、または期間平均値としてもよい。このようにすることで、ランダムノイズや窓から差し込む日光のちらつきなどによる突発的なノイズが軽減でき、ピーク位置の誤判定やゼロクロス位置（符号が反転する交点）の誤判断を軽減することができる。
【００７７】
また、時間変化を演算するとは、距離センサ１１より一定時間間隔で距離を取得することにより、距離センサ１１より取得された距離と、距離情報保存部２５に時系列的に保存された距離との差を取ることにより得られる就寝者２の形状変化を抽出することである。これは、例えば就寝者２の呼吸、体動、移動を抽出することである。これにより、抽出された就寝者２の呼吸は、波形パターンを形成する。
図１３は、波形パターンの例を示した図である。
【００７８】
さらに制御部２１内には、検出処理装置としての検出処理部２３が備えられている。検出処理部２３は、演算部２２により演算された時間変化に基づいて就寝者２の形状変化を検出するように構成されている。即ち就寝者２の呼吸、体動、移動を検出するように構成されている。また、検出処理部２３は、複数の距離センサ１１のうち１つ又は複数の選択された距離センサ１１に関する時間変化に基づいて就寝者２の形状変化を検出するように構成してもよい。
【００７９】
また検知処理部２３は、検出された形状変化中の周期的変化の周期及び振幅のいずれか一方又は両方に基づいて就寝者２の状態を判断するように構成されている。
【００８０】
さらに検出処理部２３は、対象点５までの距離と、距離情報保存部２５に保存された基準距離とを比較することにより、就寝者２の在床の検出を行うように構成されている。また検知処理部２３は、この比較により、対象点５までの距離と、基準距離との差が最も大きい距離センサ１１を選択するようにしてもよい。そして、選択された距離センサ１１に関する時間変化に基づいて就寝者２の呼吸、体動、移動を検出するようにしてもよい。
【００８１】
また検出処理部２３は、検出された形状変化中の周期的変化（就寝者２の呼吸）が一定時間検出された後に、就寝者２が監視領域５０内にある、即ち就寝者２の在床を判断するように構成してもよい。また監視装置１は、就寝者２の在床を判断したことを条件に、就寝者２の危険状態の判断を開始するようにしてもよい。一定時間は、呼吸を安定して検出できる時間であり、例えば３０～１２０秒、より好ましくは、３０～９０秒である。
【００８２】
また、検出処理装置２３は、検出された形状変化中の推移的変化を検出した後に、周期的変化を検出することがなく、一定時間以上、推移的変化及び周期的変化を共に検出できない状態になったとき、監視対象物２が監視対象領域５０の外に出た、即ち就寝者２が離床

したと判断するように構成するとよい。前記一定時間は、例えば１～３分程度である。例えば、体動、移動を検出した後、実際に就寝者２が離床した場合には、時間変化の値は、徐々に下がってくるため、変化量だけで見ていると、呼吸を検出する範囲になる時間があり、そしてその後何も検出されなくなる。このため、離床の判断を、推移的変化及び周期的変化を共に検出できない状態になったときとしている。但し、このようになる前に、呼吸が検出されていれば、体動又は移動を検出した後に、安静状態となっていることを意味しているから、その後呼吸、体動、移動がなくなれば、危険な状態であると判断しなければならない。

【００８３】

また検出処理装置２３は、検出された就寝者２の連続的形状変化に基づき、周期的変化の周期を監視するように構成してもよい。即ち、検出処理装置２３は、検出された就寝者２の呼吸、体動、移動に基づき、就寝者２の呼吸の周期を監視するように構成されている。また検知処理部２３は、周期的変化の周期及び振幅のいずれか一方又は両方に基づいて就寝者２の形状変化を検出するように構成されている。さらに、検出処理装置２３は、呼吸の周期から呼吸数を監視するように構成してもよい。ここで、呼吸数を監視することも、周期を監視する概念に含まれるものとする。

【００８４】

検出処理部２３による就寝者２の形状変化を検出するには、いくつかの方法があり、以下に典型的な例を示す。

【００８５】

まず就寝者２の形状変化を検出する第１の方法としては、複数の距離センサ１１の中から過去の直近の一定時間における時間変化が最大の距離センサ１１を選択し、選択された距離センサ１１に対応する時間変化に基づいて、就寝者２の形状変化を検出するようにする。この場合には、距離センサ１１を選択する方法として、就寝者２の過去数回程度の呼吸周期（数秒から十数秒程度）の間で最も時間変化の変動の大きい距離センサ１１を選択する方法が有効である。これは複数の距離センサ１１のそれぞれに対応する対象点５の位置によって、それぞれの対象点５に対応する時間変化に反映される就寝者２の呼吸、体動、移動の反映のされ方が異なる。このため、検出処理部２３は、呼吸のような微小な変化を検出するためには、それを的確に反映している時間変化に対応する距離センサ１１を選択することが有効であるからである。

【００８６】

このように選択した距離センサ１１は、就寝者２の体動、例えば寝返りを打ったりして動くことにより変わる可能性があるが、このような場合には、安静状態になってから一定の時間で、最も時間変化の変動の大きい距離センサ１１が再び選択され、周期的変化、即ち呼吸が検出されるようになる。この場合、検出された信号の１周期が１呼吸に対応することになる。また就寝者２が動いているときには、呼吸よりも遥かに大きい時間変化の変動が検出されるので、就寝者２が体動状態であることがわかる。この一定の時間は、最も時間変化の変動の大きい距離センサ１１を選択するのに適した時間であり、言い換えれば、就寝者２が安静状態になったことが時間変化に反映されるまでの時間である。これは、例えば周期的変化の振幅だけを評価するなら、数秒（例えば３秒）～２０秒程度、より好ましくは１０～１５秒程度である。また、周波数解析をして呼吸数を評価するなら、３０～９０秒程度である。また、安静状態とは、推移的変化即ち体動、移動が検出されなくなった状態である。推移的変化が検出されなくなった状態は、第２の実施の形態で詳述するように、例えば閾値を設定し、時間変化がこの閾値を上回った場合に、推移的変化があったと判断し、そしてこの閾値を下回った場合に推移的変化が検出されなくなった状態になったと判断するようにすれば判る。

【００８７】

また、時間変化が一定値以上の距離センサを選択し、選択された各々の時間変化の周期的変化を検出して、もっとも周期性が明瞭（呼吸を表している）な周期的変化から呼吸の有無及び呼吸数を評価するようにしてもよい。

【0088】
就寝者２の形状変化を検出する第２の方法としては、検知処理部２３は、複数の距離センサ１１を全て選択し、選択されたこれら全ての距離センサ１１の出力の時間変化の総和を求め、この総和に基づいて、就寝者２の形状変化を検出するようにする。この方法は、全ての距離センサ１１から出力された距離の時間変化の総和に基づいて就寝者２の形状変化を検出するので、必ずしも、最も感度がよいとは言えないが、最も簡便な方法であり、高速処理が容易に実現できる。また距離の時間変化の総和として、距離センサ１１から出力された距離と、基準距離との差の総和としてもよい。この場合、検出された信号の１周期が１呼吸に対応することになる。

【0089】
就寝者２の形状変化を検出する第３の方法としては、検知処理部２３は、絶対値が一定値を越える時間変化を選択し、選択された時間変化の平均値に基づいて、就寝者２の形状変化を検出するようにする。この方法は、距離の時間変化の平均値に基づいて就寝者２の形状変化を検出するので、就寝者２の部分的な大きい動きが全体で薄められて呼吸の動きに近い大きさになり、就寝者２の呼吸の検出に影響するのを防ぐことができる。この場合、検出された信号の１周期が１呼吸に対応することになる。

【0090】
就寝者２の形状変化を検出する第４の方法としては、検知処理部２３は、絶対値が一定値を越える時間変化を選択し、選択された時間変化の絶対値の平均値に基づいて、就寝者２の形状変化を検出するようにする。この方法は、距離の時間変化の絶対値の平均値に基づいて就寝者２の形状変化を検出するので、例えば、絶対値が一定値を越える距離の時間変化が複数選択され、選択された複数の距離の時間変化に正負があっても、それぞれが相殺されずに積算されるので、呼吸のような小さい変化に対して感度がよくなる。この場合、検出された信号の２周期が１呼吸に対応することになる。

【0091】
就寝者２の形状変化を検出する第５の方法としては、検知処理部２３は、複数の選択された距離センサ１１に関する時間変化の各々の位相を互いに比較し、この比較により位相が近いもの各々をグループ化して、各グループの時間変化の総和を求める。そして、逆位相に近いグループ間で、各々のグループの総和を差算する。検知処理部２３は、この差算より得られた値に基づいて、就寝者２の形状変化を検出する。この方法は、時間変化の各々の位相が近いもの各々をグループ化して、総和を求めるので、例えば、就寝者２の呼吸をグループとして抽出して増幅できる。さらに逆位相に近いグループ間で、各々のグループの総和を差算し、差算より得られた値に基づいて就寝者２の形状変化を検出するので、例えば就寝者２の呼吸により、上がる部分と下がる部分があったとしても、差算することで、呼吸パターン振幅を増幅させることができ、呼吸を確実に検出することができる。この場合、検出された信号の１周期が１呼吸に対応することになる。

【0092】
就寝者２の形状変化を検出する第６の方法としては、検出処理装置２３は、複数の距離センサ１１の全ての出力の周波数スペクトルを算出して、前記算出された周波数スペクトルのピークの鋭さが一定値以上であり、且つ前記鋭さが最も高い距離センサ１１を選択し、前記選択された距離センサ１１に関する時間変化に基づいて、監視対象物２の形状変化を検出するように構成してもよい。

【0093】
ピークの鋭さ（ピークの先鋭度）は、例えば、スペクトルピークの高さを全周波数のスペクトルの高さの積分値で除算した値、またディスクリートな場合には、例えば、ピーク高さに、ピークのとなりのスペクトルの高い方の高さを加算した値を、さらに全周波数のスペクトルの高さの和で除算した値を指標とすることができる。ピークの鋭さが一定値以上であることを評価することで、明確に例えば就寝者２の呼吸を検出している距離センサ１１を選択することができるので、就寝者２の呼吸を検出しやすい。

【0094】

就寝者２の形状変化を検出する第７の方法としては、検出処理装置２３は、前記時間変化の絶対値が所定の幅にある距離センサ１１の出力の周波数スペクトルを算出し、前記算出された周波数スペクトルのピークの鋭さが一定値以上であり、且つ前記鋭さが最も高い距離センサ１１を選択し、前記選択された距離センサ１１に関する時間変化に基づいて、監視対象物２の形状変化を検出するように構成するとよい。この方法では、時間変化の絶対値が所定の幅を就寝者２の呼吸が存在する領域に設定することで、就寝者２の呼吸を検出しやすくなる。

【００９５】

就寝者２の形状変化を検出する第８の方法としては、検出処理装置２３は、前記時間変化の絶対値が大きい方から複数個の距離センサ１１の出力の周波数スペクトルを算出し、前記算出された周波数スペクトルのピークの鋭さが一定値以上であり、且つ前記鋭さが最も高い距離センサ１１を選択し、前記選択された距離センサ１１に関する時間変化に基づいて、監視対象物２の形状変化を検出するように構成するとよい。

【００９６】

検知処理部２３は、以上のような検出方法を用いて、就寝者２の形状変化を検出する。監視装置１は、検出された形状変化に基づいて就寝者２の状態を判断する。例えば、短時間に呼吸パターンの持つ周期が乱れた場合又は、呼吸パターンの持つ周期が急激に変化した場合には、例えば、自然気胸、気管支喘息などの肺疾患、うっ血性心不全などの心疾患、または、脳出血などの脳血管疾患であると推測できる。また、呼吸パターンの消失が続いた場合には、就寝者２の呼吸が停止したと推測できる。そして、短時間に呼吸パターンではなく就寝者２の体動が頻出した場合には、就寝者２が何らかの理由で苦しんで暴れているような状況が推測できる。

【００９７】

また、就寝者２の体動や移動の検出は、時間変化から呼吸のみを検出した場合に比べて、遥かに大きく変動するので、容易に検出することができる。この場合には、さらに検知処理部２３は、複数の距離センサ１１に対応する各々の時間変化より、就寝者２が、例えば寝返り等その場で動いているのか、例えばベッドから起き上がる等の移動をしているのかを検出することもできる。また、就寝者２が痙攣のような周期的で小さい動きをした場合でも、その波形パターンから異常を検出することができる。さらに、痙攣している状態の波形パターンを記憶部２４に保存しておくことで、就寝者２が痙攣している状態と検出することもできる。

【００９８】

図１４を参照して、正常および異常な呼吸パターンの例を説明する。記憶部２４内の呼吸パターン保存部２６に保存されている正常な呼吸パターンは、図１４（ａ）に示したような、周期的なパターンである。ただし、大人の場合には、１分間の呼吸数として正常な範囲は、１０～２０回程度である。呼吸パターン保存部２６に保存されている異常な呼吸パターンは、例えば、チェーン－ストークス（Ｃｈｅｙｎｅ－Ｓｔｏｋｅｓ）呼吸、中枢性過換気、失調性呼吸、カスマウル（Ｋｕｓｓｍｕｌ）の大呼吸など、生理学的に体内に障害が発生している場合に生じると考えられている呼吸パターンである。

【００９９】

図１４（ｂ）に、Ｃｈｅｙｎｅ－Ｓｔｏｋｅｓ呼吸の呼吸パターンを、図１４（ｃ）に中枢性過換気の呼吸パターンを、図１４（ｄ）に失調性呼吸の呼吸パターンをそれぞれ示す。

さらに図１５に、上記の異常な呼吸パターンが発生した場合の、病名または疾患箇所について示す。

【０１００】

検知処理部２３は、それぞれの呼吸パターンの呼吸の周波数、出現回数、深浅が異なることを利用して、就寝者２の呼吸パターンがいずれの呼吸パターンに属するかを判別し、就寝者２の状態を判断する。

【０１０１】

さらに検知処理部２３は、就寝者２の呼吸が、生理学的に体内に障害が発生している湯合に生じると考えられている呼吸パターンに属すると判定した場合に、就寝者２が異常な呼吸をしており危険な状態にあると検出する。このように検出された就寝者２の状態は、制御部２１により出力装置２８から出力される。また出力される内容は、検出された就寝者２の呼吸数や動きの頻度、異常な呼吸パターンの名称やその呼吸の原因となると考えられる病名、疾患器官、疾患箇所などである。

【０１０２】

また以上では、距離センサ１１は、複数の場合で説明したが、１個であってもよく、その場合には、監視装置１を単純化でき、小型化できる。また監視装置１は、処理する距離センサ１１からの出力の数が減少するので高速処理ができる。

【０１０３】

以上のような第１の実施の形態によれば、就寝者２の呼吸を確実に検出することができ、就寝者２の状態を判断することができる。しかも、心理的に違和感のあるカメラを用いた画像処理を使用していないので、簡易な装置で高速処理が可能である。さらに、高齢者や病人が危機状態に陥った場合に、迅速な救急対応が可能である。

【０１０４】

【発明の効果】

以上のように本発明によれば、監視対象領域内の異なる位置に向けて設置され、監視対象物までの距離を測定する、複数の各々独立した距離センサと、前記複数の距離センサの各々の出力の時間変化を演算する演算装置と、前記複数の距離センサのうち一つ又は複数の選択された距離センサに関する前記演算された時間変化に基づいて前記監視対象物の形状変化を検出する検出処理装置とを備える場合は、監視対象物の状態を確実に検出するだけでなく、小型で、かつ単純である監視装置を提供することができる。

【図面の簡単な説明】

【図１】本発明の実施の形態である監視装置の概要を示す模式的斜視図である。

【図２】本発明の実施の形態である対象点の配置例（ａ）と対象点が重複する配置例（ｂ）を説明する模式的平面図である。

【図３】本発明の実施の形態で用いる監視装置の構成例を示すブロック図である。

【図４】本発明の実施の形態である距離センサを、カーブをつけて設置する場合を説明する模式的側面図である。

【図５】本発明の実施の形態で用いる赤外線距離センサの構成例を示すブロック図である。

【図６】図５の場合における、ＰＳＤについて説明する（ａ）模式的平面図、（ｂ）模式的正面断面図である。

【図７】本発明の実施の形態で、監視対象物の距離を算出する方法を説明する模式図である。

【図８】本発明の実施の形態で用いる超音波センサの構成例を示すブロック図である。

【図９】本発明の実施の形態で用いる電磁波パルス距離センサの構成例を示すブロック図である。

【図１０】本発明の実施の形態で用いるパッシブ型光学距離センサの構成例を示すブロック図である。

【図１１】図１０の場合における、照明パターンについて示した概要図である。

【図１２】図１０の場合における、１対のラインＣＣＤの視差から、監視対象物の距離を算出する方法を説明する模式図である。

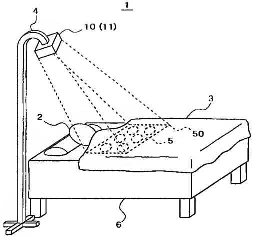
【図１３】本発明の実施の形態で用いる、呼吸の波形パターンについて示した概要図である。

【図１４】図１３の場合における、正常及び異常な呼吸の波形パターンについて示した概要図である。

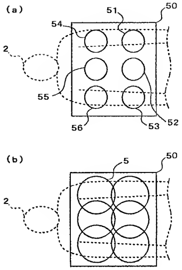
【図１５】図１４の場合における、異常な呼吸の波形パターンに対応する病名または疾患箇所の表を示した図である。

【符号の説明】
1　監視装置
2　就寝者
3　寝具
4　スタンド
5　対象点
6　ベッド
１０　筐体
１１　距離センサ
２０　制御装置
２１　制御部
２２　演算部
２３　検出処理部
２４　記憶部
２５　距離情報保存部
２６　呼吸パターン保存部
２７　入力装置
２８　出力装置
２９　インターフェイス
３０　赤外線距離センサ
３１　赤外光照射部
３２　赤外光受光部
４０　パッシブ型光学距離センサ
４１　第１の受光部
４２　第２の受光部
４７　差画像形成部
４８　相関出力算出部
５０　監視領域
７０　超音波センサ
８０　電磁波パルス距離センサ

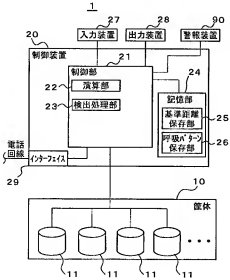
【図１】


1
4
10 (11)
3
2
50
5
6

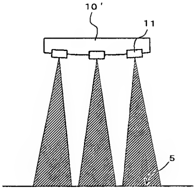
【図２】


(a)
51
50
54
2
55
56
53
52
(b)
5
50
2

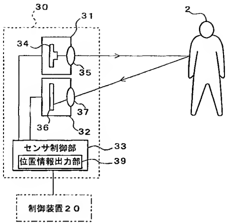
【図３】


1
27
28
90
20
入力装置
出力装置
警報装置
制御装置
21
制御部
24
22
演算部
23
検出処理部
記憶部
基準距離
保存部
25
呼吸パターン
保存部
26
電話
回線
インターフェイス
29
10
筐体
11
11
11
11

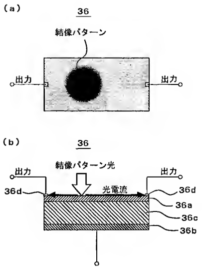
【図４】


10'
11
5

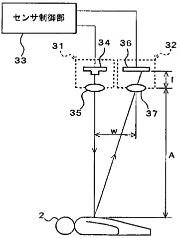
【図５】


30
31
2
34
35
37
36
32
センサ制御部
位置情報出力部
33
39
制御装置２０

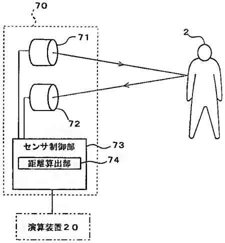
【図６】


(a)
36
結像パターン
出力
出力
(b)
36
結像パターン光
出力
出力
光電流
36d
36d
36a
36c
36b

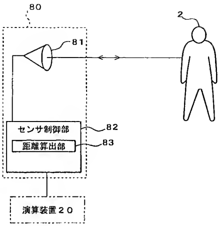
【図７】


センサ制御部
33
31
34
36
32
f
35
37
w
A
2

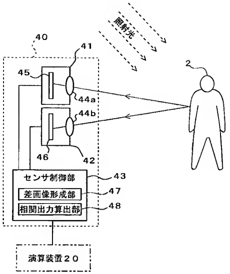
【図８】


70
71
2
72
センサ制御部
距離算出部
73
74
演算装置２０

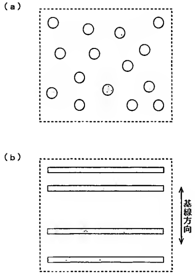
【図９】



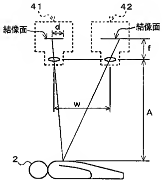
【図１０】



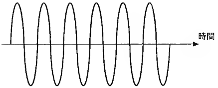
【図１１】



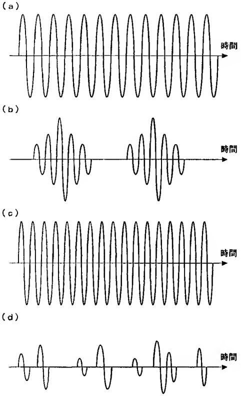
【図１２】



【図１３】



【図１４】



【図１５】

Cheyne-Stokes 呼吸	両側大脳皮質下および間脳の障害
中枢性過換気	中脳下部から橋上部の障害
失調性呼吸	橋下部から延髄上部の障害
Kussmaul の大呼吸	糖尿病性昏睡または尿毒症

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特開平08－150125（JP，A）
特開昭63－281627（JP，A）
特開2000－217802（JP，A）
特開2000－105281（JP，A）

(58)調査した分野(Int.Cl.，DB名)
A61B 5/11

CLAIMS

(57)[Claim(s)]
[Claim 1]
Two or more distance sensors which are installed towards a different position in a surveillance object field, and measure distance to a supervisory object and which became independent respectively;
An arithmetic unit which calculates a temporal change of each output of two or more of said distance sensors;
It has a detection processing device which a temporal change in the latest past fixed time chooses the greatest distance sensors, and detects a shape change of said supervisory object based on a temporal change corresponding to said selected distance sensors out of said two or more distance sensors.;
A temporal change in fixed time after this supervisory object is in a quiet state chooses the greatest distance sensors, and said detection processing device detects a shape change of said supervisory object based on the temporal change, when transitive change of said supervisory object is detected.;
A monitoring instrument.
[Claim 2]
Two or more distance sensors which are installed towards a different position in a surveillance object field, and measure distance to a supervisory object and which became independent respectively;
An arithmetic unit which calculates a temporal change of each output of two or more of said distance sensors;
It has a detection processing device which detects a shape change of said supervisory object based on said calculated temporal change about one or more selected distance sensors among said two or more distance sensors.;
Said detection processing device chose said two or more distance sensors of all, asked for total of a temporal change of an output of said selected distance sensors, and based on this total, it was constituted so that a shape change of said supervisory object might be detected.;
A monitoring instrument.
[Claim 3]
Two or more distance sensors which are installed towards a different position in a surveillance object field, and measure distance to a supervisory object and which became independent respectively;
An arithmetic unit which calculates a temporal change of each output of two or more of said distance sensors;
It has a detection processing device which detects a shape change of said supervisory object based on said calculated temporal change about one or more selected distance sensors among said two or more distance sensors.;

Said detection processing device computes frequency spectrum of all the outputs of two or more of said distance sensors, Sharpness of a peak of said computed frequency spectrum is beyond constant value, and said sharpness chose the highest distance sensors, and based on a temporal change about said selected distance sensors, it was constituted so that a shape change of said supervisory object might be detected.;
A monitoring instrument.
[Claim 4]
Two or more distance sensors which are installed towards a different position in a surveillance object field, and measure distance to a supervisory object and which became independent respectively;
An arithmetic unit which calculates a temporal change of each output of two or more of said distance sensors;
It has a detection processing device which detects a shape change of said supervisory object based on said calculated temporal change about one or more selected distance sensors among said two or more distance sensors.;
Said detection processing device computes frequency spectrum of an output of distance sensors which have an absolute value of said temporal change in predetermined width, Sharpness of a peak of said computed frequency spectrum is beyond constant value, and said sharpness chose the highest distance sensors, and based on a temporal change about said selected distance sensors, it was constituted so that a shape change of said supervisory object might be detected.;
A monitoring instrument.
[Claim 5]
Two or more distance sensors which are installed towards a different position in a surveillance object field, and measure distance to a supervisory object and which became independent respectively;
An arithmetic unit which calculates a temporal change of each output of two or more of said distance sensors;
It has a detection processing device which detects a shape change of said supervisory object based on said calculated temporal change about one or more selected distance sensors among said two or more distance sensors.;
Said detection processing device computes frequency spectrum of an output of two or more distance sensors from the one where an absolute value of said temporal change is larger, Sharpness of a peak of said computed frequency spectrum is beyond constant value, and said sharpness chose the highest distance sensors, and based on a temporal change about said selected distance sensors, it was constituted so that a shape change of said supervisory object might be detected.;
A monitoring instrument.
[Claim 6]
Two or more distance sensors which are installed towards a different position in a surveillance object field, and measure distance to a supervisory object and which became independent respectively;
An arithmetic unit which calculates a temporal change of each output of two or more of said distance sensors;
It has a detection processing device which detects a shape change of said supervisory object based on said calculated temporal change about one or more selected distance sensors among said two or more distance sensors.;
An absolute value of <u>said temporal change</u> chose <u>distance sensors</u> exceeding constant value, and based on average value of a temporal change <u>about said selected distance sensors</u>, said detection processing device was constituted so that a shape change of said supervisory object might be detected.;
A monitoring instrument.

[Claim 7]
Two or more distance sensors which are installed towards a different position in a surveillance object field, and measure distance to a supervisory object and which became independent respectively;
An arithmetic unit which calculates a temporal change of each output of two or more of said distance sensors;
It has a detection processing device which detects a shape change of said supervisory object based on said calculated temporal change about one or more selected distance sensors among said two or more distance sensors.;
An absolute value of said temporal change chose distance sensors exceeding constant value, and based on average value of an absolute value of a temporal change about said selected distance sensors, said detection processing device was constituted so that a shape change of said supervisory object might be detected.;
A monitoring instrument.
[Claim 8]
Two or more distance sensors which are installed towards a different position in a surveillance object field, and measure distance to a supervisory object and which became independent respectively;
An arithmetic unit which calculates a temporal change of each output of two or more of said distance sensors;
It has a detection processing device which detects a shape change of said supervisory object based on said calculated temporal change about one or more selected distance sensors among said two or more distance sensors.;
Said detection processing device compares mutually each phase of said temporal change about selected distance sensors of said plurality, and said phase carries out grouping of the near things of each by said comparison, It asked for total of each of said group's temporal change, and said said a group's total of each was ****(ed) among groups near an opposite phase, and based on a value obtained from the aforementioned difference **, it was constituted so that a shape change of said supervisory object might be detected.;
A monitoring instrument.
[Claim 9]
Said detection processing device was constituted so that a state of said supervisory object might be judged based on both a cycle of a periodic change under said detected shape change, and both [either or].;
A monitoring instrument given in any 1 paragraph of claim 1 thru/or claim 8.
[Claim 10]
It was constituted so that it might judge that said detection processing device has said supervisory object in said surveillance object field when a periodic change under said detected shape change continues beyond in fixed time.;
A monitoring instrument given in any 1 paragraph of claim 1 thru/or claim 9.
[Claim 11]
The Mitsuteru gunner stage to which said distance sensors irradiate said supervisory object with light flux, It has an image formation optical system which carries out image formation of the image of an optical irradiation pattern generated by this optical irradiation means on said supervisory object, and based on an image formation position of image formation pattern light in which image formation is carried out by said image formation optical system, it was constituted so that an output corresponding to said distance might be obtained by trigonometry.;
A monitoring instrument given in any 1 paragraph of claim 1 thru/or claim 10.
[Claim 12]
Based on information on two or more image formation devices which carry out image formation of

said supervisory object with an individual optic axis, and an image formation position from said image formation device, said distance sensors were constituted so that an output corresponding to said distance might be obtained by trigonometry.;
A monitoring instrument given in any 1 paragraph of claim 1 thru/or claim 10.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention]
This invention relates to the monitoring instrument for supervising change of breathing of a sleeping person etc. especially about the monitoring instrument which supervises a supervisory object.
[0002]
[Description of the Prior Art]
The device which supervises change of breathing of a sleeping person from the former as a monitoring instrument which supervises change of breathing of a sleeping person based on time transition of the pressure distribution detected with the load sensor or the pressure sensor is proposed.
[0003]
[Problem(s) to be Solved by the Invention]
However, in order to acquire and detect the stable signal from the signal of a monitoring instrument measured being minute according to the above conventional devices, it became a highly efficient signal amplifier and a certain signal processing are required, and complicated as a system, and large-scale.
[0004]
Then, it not only detects the state of a supervisory object certainly, but an object of this invention is to provide a small and simple monitoring instrument.
[0005]
[Means for Solving the Problem]
To achieve the above objects, a monitoring instrument by invention concerning claim 1, For example, as shown in drawing 1 and drawing 3, it is installed towards a different position in the surveillance object field 50, Two or more distance sensors 11 which measure distance to a supervisory object and which became independent respectively, and the arithmetic unit 22 which calculates a temporal change of each output of the distance sensors 11 of; plurality; out of two or more distance sensors 11. A temporal change in the latest past fixed time chooses the greatest distance sensors 11, Based on a temporal change corresponding to said selected distance sensors 11, have the detection processing device 23 which detects a shape change of the supervisory object 2, and; detection processing device 23, After the supervisory object 2 is in a quiet state, a temporal change in the latest fixed time chooses the greatest distance sensors 11, and when transitive change of the supervisory object 2 is detected, based on the temporal change, it is constituted so that a shape change of the supervisory object 2 may be detected.
[0006]
Since it will have two or more distance sensors 11 which became independent respectively, and the arithmetic unit 22 which calculates a temporal change of outputs of two or more distance sensors

11 if constituted in this way, a temporal change of distance to a supervisory object can be obtained, for example. Out of two or more distance sensors 11, a temporal change in the latest past fixed time chooses the greatest distance sensors 11, and a shape change of the supervisory object 2 is detected based on a temporal change corresponding to said selected distance sensors 11, Since a temporal change in the latest fixed time chooses the greatest distance sensors 11 and a shape change of the supervisory object 2 is detected based on the temporal change after the supervisory object 2 is in a quiet state when transitive change of the supervisory object 2 is detected, a sleeping person's breathing is detectable, for example. Thereby, it not only can detect a sleeping person's condition certainly, but it can provide a small and simple monitoring instrument.

[0007]

To achieve the above objects, a monitoring instrument by invention concerning claim 2, For example, as shown in drawing 1 and drawing 3, it is installed towards a different position in the surveillance object field 50, . Measure distance to the supervisory object 2. Two or more distance sensors 11 which became independent respectively, and the arithmetic unit 22 which calculates a temporal change of each output of the distance sensors 11 of; plurality; Based on said calculated temporal change about one or more selected distance sensors 11, among two or more distance sensors 11, a shape change of the supervisory object 2. It has the detection processing device 23 to detect, and; detection processing device 23 chooses two or more distance sensors 11 altogether, asks for total of a temporal change of an output of said selected distance sensors 11, and based on this total, it is constituted so that a shape change of said supervisory object 2 may be detected.

[0008]

Since it has two or more distance sensors 11, arithmetic units 22, and detection processing devices 23 if constituted in this way, based on said calculated temporal change about one or more selected distance sensors 11, a shape change of the supervisory object 2 is detectable among two or more distance sensors 11. Since the detection processing device 23 chooses two or more distance sensors 11 altogether, asks for total of a temporal change of an output of said selected distance sensors 11, and it is constituted based on this total so that a shape change of said supervisory object 2 may be detected, high speed processing is possible for it, for example. Thereby, it not only can detect a sleeping person's condition certainly, but it can provide a small and simple monitoring instrument.

[0009]

To achieve the above objects, a monitoring instrument by invention concerning claim 3, For example, as shown in drawing 1 and drawing 3, it is installed towards a different position in the surveillance object field 50, . Measure distance to the supervisory object 2. Two or more distance sensors 11 which became independent respectively, and the arithmetic unit 22 which calculates a temporal change of each output of the distance sensors 11 of; plurality; Based on said calculated temporal change about one or more selected distance sensors 11, among two or more distance sensors 11, a shape change of the supervisory object 2. Have the detection processing device 23 to detect and; detection processing device 23, Frequency spectrum of all the outputs of two or more distance sensors 11 is computed, Sharpness of a peak of said computed frequency spectrum is beyond constant value, and said sharpness chooses the highest distance sensors 11, and based on a temporal change about said selected distance sensors, it is constituted so that a shape change of the supervisory object 2 may be detected.

[0010]

Since it has two or more distance sensors 11, arithmetic units 22, and detection processing devices 23 if constituted in this way, based on said calculated temporal change about one or more selected distance sensors 11, a shape change of the supervisory object 2 is detectable among two or more distance sensors 11. The detection processing device 23 computes frequency spectrum of all the outputs of two or more distance sensors 11, Sharpness of a peak of said computed frequency spectrum is beyond constant value, And since it is constituted so that said sharpness may choose

the highest distance sensors 11 and may detect a shape change of the supervisory object 2 based on a temporal change about said selected distance sensors, a sleeping person's breathing is certainly detectable, for example. Thereby, it not only can detect a sleeping person's condition certainly, but it can provide a small and simple monitoring instrument.

[0011]

To achieve the above objects, a monitoring instrument by invention concerning claim 4, For example, as shown in drawing 1 and drawing 3, it is installed towards a different position in the surveillance object field 50, . Measure distance to the supervisory object 2. Two or more distance sensors 11 which became independent respectively, and the arithmetic unit 22 which calculates a temporal change of each output of the distance sensors 11 of; plurality; Based on said calculated temporal change about one or more selected distance sensors 11, among two or more distance sensors 11, a shape change of the supervisory object 2. Have the detection processing device 23 to detect and; detection processing device 23, Frequency spectrum of an output of the distance sensors 11 which have an absolute value of said temporal change in predetermined width is computed, Sharpness of a peak of said computed frequency spectrum is beyond constant value, and said sharpness chooses the highest distance sensors 11, and based on a temporal change about said selected distance sensors 11, it is constituted so that a shape change of the supervisory object 2 may be detected.

[0012]

Since it has two or more distance sensors 11, arithmetic units 22, and detection processing devices 23 if constituted in this way, based on said calculated temporal change about one or more selected distance sensors 11, a shape change of the supervisory object 2 is detectable among two or more distance sensors 11. The detection processing device 23 computes frequency spectrum of an output of the distance sensors 11 which have an absolute value of said temporal change in predetermined width, Sharpness of a peak of said computed frequency spectrum is beyond constant value, And since it is constituted so that said sharpness may choose the highest distance sensors 11 and may detect a shape change of the supervisory object 2 based on a temporal change about said selected distance sensors 11, a sleeping person's breathing is certainly detectable, for example. Thereby, it not only can detect a sleeping person's condition certainly, but it can provide a small and simple monitoring instrument.

[0013]

To achieve the above objects, a monitoring instrument by invention concerning claim 5, For example, as shown in drawing 1 and drawing 3, it is installed towards a different position in the surveillance object field 50, . Measure distance to the supervisory object 2. Two or more distance sensors 11 which became independent respectively, and the arithmetic unit 22 which calculates a temporal change of each output of the distance sensors 11 of; plurality; Based on said calculated temporal change about one or more selected distance sensors 11, among two or more distance sensors 11, a shape change of the supervisory object 2. Have the detection processing device 23 to detect and; detection processing device 23, Frequency spectrum of an output of two or more distance sensors 11 is computed from the one where an absolute value of said temporal change is larger, Sharpness of a peak of said computed frequency spectrum is beyond constant value, and said sharpness chooses the highest distance sensors 11, and based on a temporal change about said selected distance sensors 11, it is constituted so that a shape change of the supervisory object 2 may be detected.

[0014]

Since it has two or more distance sensors 11, arithmetic units 22, and detection processing devices 23 if constituted in this way, based on said calculated temporal change about one or more selected distance sensors 11, a shape change of the supervisory object 2 is detectable among two or more distance sensors 11. The detection processing device 23 computes frequency spectrum of an output of two or more distance sensors 11 from the one where an absolute value of said temporal change is larger, Sharpness of a peak of said computed frequency spectrum is beyond constant

value, And since it is constituted so that said sharpness may choose the highest distance sensors 11 and may detect a shape change of the supervisory object 2 based on a temporal change about said selected distance sensors 11, a sleeping person's breathing is certainly detectable, for example. Thereby, it not only can detect a sleeping person's condition certainly, but it can provide a small and simple monitoring instrument.

[0015]

To achieve the above objects, a monitoring instrument by invention concerning claim 6, For example, as shown in drawing 1 and drawing 3, it is installed towards a different position in the surveillance object field 50, . Measure distance to the supervisory object 2. Two or more distance sensors 11 which became independent respectively, and the arithmetic unit 22 which calculates a temporal change of each output of the distance sensors 11 of; plurality; Based on said calculated temporal change about one or more selected distance sensors 11, among two or more distance sensors 11, a shape change of the supervisory object 2. It has the detection processing device 23 to detect, and an absolute value of said temporal change chooses the distance sensors 11 exceeding constant value, and based on average value of a temporal change about said selected distance sensors 11,; detection processing device 23 is constituted so that a shape change of the supervisory object 2 may be detected.

[0016]

Since it has two or more distance sensors 11, arithmetic units 22, and detection processing devices 23 if constituted in this way, based on said calculated temporal change about one or more selected distance sensors 11, a shape change of the supervisory object 2 is detectable among two or more distance sensors 11. Since the detection processing device 23 chooses distance sensors with which an absolute value of a temporal change exceeds constant value, and it is constituted based on average value of a temporal change about selected distance sensors so that a shape change of the supervisory object 2 may be detected, it can detect a sleeping person's breathing certainly, for example. Thereby, it not only can detect a sleeping person's condition certainly, but it can provide a small and simple monitoring instrument.

[0017]

To achieve the above objects, a monitoring instrument by invention concerning claim 7, For example, as shown in drawing 1 and drawing 3, it is installed towards a different position in the surveillance object field 50, . Measure distance to the supervisory object 2. Two or more distance sensors 11 which became independent respectively, and the arithmetic unit 22 which calculates a temporal change of each output of the distance sensors 11 of; plurality; Based on said calculated temporal change about one or more selected distance sensors 11, among two or more distance sensors 11, a shape change of the supervisory object 2. It has the detection processing device 23 to detect, and an absolute value of said temporal change chooses the distance sensors 11 exceeding constant value, and based on average value of an absolute value of a temporal change about said selected distance sensors 11,; detection processing device 23 is constituted so that a shape change of the supervisory object 2 may be detected.

[0018]

Since it has two or more distance sensors 11, arithmetic units 22, and detection processing devices 23 if constituted in this way, based on said calculated temporal change about one or more selected distance sensors 11, a shape change of the supervisory object 2 is detectable among two or more distance sensors 11. Since the detection processing device 23 chooses distance sensors with which an absolute value of a temporal change exceeds constant value, and it is constituted based on average value of an absolute value of a temporal change about selected distance sensors so that a shape change of the supervisory object 2 may be detected, it can detect a sleeping person's breathing certainly, for example. Thereby, it not only can detect a sleeping person's condition certainly, but it can provide a small and simple monitoring instrument.

[0019]

To achieve the above objects, a monitoring instrument by invention concerning claim 8, For example, as shown in drawing 1 and drawing 3, it is installed towards a different position in the surveillance object field 50, . Measure distance to a supervisory object. Two or more distance sensors 11 which became independent respectively, and the arithmetic unit 22 which calculates a temporal change of each output of the distance sensors 11 of; plurality; Based on said calculated temporal change about one or more selected distance sensors 11, among two or more distance sensors 11, a shape change of the supervisory object 2. Have the detection processing device 23 to detect and; detection processing device 23, Compare mutually each phase of said temporal change about the selected distance sensors 11 of said plurality, and said phase carries out grouping of the near things of each by said comparison, ask for total of each of said group's temporal change, and among groups near an opposite phase, Said said a group's total of each is ****(ed), and based on a value obtained from the aforementioned difference **, it is constituted so that a shape change of the supervisory object 2 may be detected.

[0020]

Since it has two or more distance sensors 11, arithmetic units 22, and detection processing devices 23 if constituted in this way, based on said calculated temporal change about one or more selected distance sensors 11, a shape change of the supervisory object 2 is detectable among two or more distance sensors 11. The detection processing device 23 compares mutually each phase of said temporal change about the selected distance sensors 11 of said plurality, and said phase carries out grouping of the near things of each by said comparison, It asks for total of each of said group's temporal change, and said said a group's total of each is ****(ed) among groups near an opposite phase, and since it is constituted based on a value obtained from the aforementioned difference ** so that a shape change of the supervisory object 2 may be detected, a sleeping person's breathing is certainly detectable, for example. Thereby, it not only can detect a sleeping person's condition certainly, but it can provide a small and simple monitoring instrument.

[0021]

Like a statement to claim 9, the detection processing device 23 is good in the monitoring instrument 1 given in any 1 paragraph of claim 1 thru/or claim 8 to constitute so that a state of the supervisory object 2 may be judged based on both a cycle of a periodic change under said detected shape change, and both [either or].

[0022]

It is [like] good to constitute from the monitoring instrument 1 given in any 1 paragraph of claim 1 thru/or claim 9 so that it may judge that the detection processing device 23 has the supervisory object 2 in the surveillance object field 50 when [according to claim 10] a periodic change under said detected shape change continues beyond in fixed time.

[0023]

Since it is constituted so that it may judge that the supervisory object 2 is in the surveillance object field 50 when a periodic change under said detected shape change continues beyond in fixed time if constituted in this way, a sleeping person's lying in bed is detectable, for example.

[0024]

In the above monitoring instrument 1, the detection processing device 23, When it changes into the state where a periodic change is not detected and beyond fixed time can detect neither transitive change nor a periodic change after detecting transitive change under said detected shape change, it is good to constitute so that it may judge that the supervisory object 2 came out of the surveillance object field 50. If constituted in this way, a sleeping person's bed leaving can be judged, for example.

[0025]

To claim 11, like a statement in the monitoring instrument 1 of a statement, in any 1 paragraph of claim 1 thru/or claim 10. For example, as shown in drawing 5, the distance sensors 30, It has the Mitsuteru gunner stage 31 which irradiates the supervisory object 2 with light flux, and the image

formation optical system 37 which carries out image formation of the image of an optical irradiation pattern generated by the Mitsuteru gunner stage 31 on the supervisory object 2, It is good to constitute based on an image formation position of image formation pattern light in which image formation is carried out by the image formation optical system 37, so that an output corresponding to said distance may be obtained by trigonometry.

[0026]

The Mitsuteru gunner stage 31 to which the distance sensors 30 will irradiate the supervisory object 2 with light flux if constituted in this way, It has the image formation optical system 37 which carries out image formation of the image of an optical irradiation pattern generated by the Mitsuteru gunner stage 31 on the supervisory object 2, Since it is constituted based on an image formation position of image formation pattern light in which image formation is carried out by the image formation optical system 37 so that an output corresponding to said distance may be obtained by trigonometry, it can be considered as the cheap and simple monitoring instrument 1.

[0027]

To claim 12, like a statement in the monitoring instrument 1 of a statement, in any 1 paragraph of claim 1 thru/or claim 10. For example, based on information on the two or more image formation devices 41 and 42 which carry out image formation of the supervisory object 2 with an individual optic axis, and an image formation position from the image formation devices 41 and 42, as shown in drawing 10, the distance sensors 40 may be constituted so that an output corresponding to said distance may be obtained by trigonometry.

[0028]

The two or more image formation devices 41 and 42 to which the distance sensors 40 will carry out image formation of the supervisory object 2 with an individual optic axis if constituted in this way, Since it is constituted based on information on an image formation position from the image formation devices 41 and 42 so that an output corresponding to said distance may be obtained by trigonometry, it can be considered as the cheap and simple monitoring instrument 1.

[0029]

To achieve the above objects, a monitoring instrument by this invention, For example, as shown in drawing 1 and drawing 3, it is installed towards inside of the surveillance object field 50, The distance sensors 11 which measure distance to the supervisory object 2, and the arithmetic unit 22 which calculates a temporal change of an output of the; distance sensors 11; Have the detection processing device 23 which detects a shape change of the supervisory object 2 based on said calculated temporal change, and; detection processing device 23, When a periodic change under said detected shape change continues beyond in fixed time, it may be constituted so that it may judge that the supervisory object 2 is in the surveillance object field 50.

[0030]

Since it has the distance sensors 11, the arithmetic unit 22, and the detection processing device 23 if constituted in this way, a temporal change of an output of the distance sensors 11 can be calculated, and a shape change of the supervisory object 2 can be detected based on said calculated temporal change. Since it is constituted so that it may judge that the detection processing device 23 has the supervisory object 2 in the surveillance object field 50 when a periodic change under said detected shape change continues beyond in fixed time, a sleeping person's breathing and lying in bed are detectable, for example. It can constitute simply. Thereby, it not only can detect a sleeping person's condition certainly, but it can provide a small and simple monitoring instrument.

[0031]

[Embodiment of the Invention]

Hereafter, an embodiment of the invention is described with reference to drawings. Identical codes or similar numerals are given to the member which is mutually the same or corresponds in each figure, and the duplicate explanation is omitted.

[0032]
Drawing 1 is a typical perspective view of the monitoring instrument 1 which is an embodiment by this invention. The sleeping person 2 as a thing which is a supervisory object and carries out a periodic change to the bed 6 upper surface (henceforth the monitor area 50) as a surveillance object field in a figure lies and exists. On the sleeping person 2, the bedding 3 is covered further, and some sleeping persons 2 and some beds 6 are covered. That is, the monitoring instrument 1 is supervising the upper surface of the bedding 3. The bedding 3 is not used but it may be made for the monitoring instrument 1 to supervise the sleeping person's 2 idiosoma itself. In this embodiment, a shape change is a successive change and a successive change is a concept including a periodic change and transitive change. The sleeping person's 2 shape changes are the sleeping person's 2 periodic change, and transitive change, for example. The sleeping person's 2 periodic change is the sleeping person's 2 breathing, for example. The sleeping person's 2 transitive change is the sleeping person's 2 body motion, and movement, for example. A periodic change is the cycle of breathing of a person (sleeping person), for example, change of per minute five to 60 cycle, for example. That is, according to this embodiment, a periodic change does not include the periodic change from which it separated greatly from the cycle of breathing. By the way, although a grown-up breathing rate is in about per minute 5 to 30 times of ranges, in the case of a small child, there is a tendency for a breathing rate to increase further.
[0033]
Based on the sleeping person's 2 detected shape change, the monitoring instrument 1 is constituted so that the sleeping person's 2 condition may be judged. The sleeping person's 2 condition is in movement, for example, the implantation, and the state where it carries out bed leaving etc. which are carrying out normal breathing, for example and which are carrying out unusual breathing and have struck, dangerous body motion, for example, changing sides.
[0034]
On the other hand, the case 10 constituted including two or more distance sensors 11 which measure the distance to the sleeping person 2 who exists in the monitor area 50 is installed in the stand 4 in a figure. Two or more distance sensors 11 are installed in the case 10 corresponding to two or more surveillance object points (henceforth a target point). According to this embodiment, although the case 10 (distance sensors 11) is installed in the stand 4, when a wall and a ceiling exist, a wall and a ceiling may be sufficient as it and a setting position may determine it suitably with the purpose, specification, etc. of a monitoring instrument. The stand 4 is movable and makes installation of the case 10 easy. As for the distance sensors 11, it is preferred to arrange two or more rows to the case 10.
[0035]
With reference to the example of arrangement of the target point of the schematic plan view of drawing 2, a target point is suitably explained with reference to drawing 1. As shown in drawing 2 (a), two or more target points corresponding to two or more distance sensors 11 are arranged so that each target point may not lap with a ****** target point. In this case, for example like a graphic display, two or more target points are arranged in a grid pattern so that the target points 51, 52, 53, 54, 55, and 56 (it is only called the target point 5 when not distinguishing a target point below) may not lap with the monitor area 50 mutually. As for two or more target points 5, it is preferred to set it as the range which covers the position of the sleeping person 2 on the bed 6 (under the bedding 3) which can be about taken while an abdomen, a thorax, regions of back, and a shoulder go to bed. In this embodiment, although the number to arrange is two rows (it expresses the following 3x2) of three lines, it may be suitably decided by the conditions of the place to supervise, the sleeping person 2, etc., for example, 3x3 and 4x4 may be sufficient as it. Thus, even when two or more target points 5 were arranged and the glared type sensor which measures distance by irradiating the distance sensors 11 with light or an ultrasonic wave is used, It is not necessary to control the distance sensors 11 corresponding to the adjoining target point 5 not to glare simultaneously like

the after-mentioned, and they can consider the monitoring instrument 1 as easier composition.
[0036]
As shown in the example of arrangement of the target point 5 of the schematic plan view of drawing 2 (b), the ****** target point 5 may lap. Since the dead angle in the monitor area 50 can be lessened if it does in this way, it is effective in higher-precision surveillance. To use the glared type sensor which measures distance by irradiating the distance sensors 11 with light or an ultrasonic wave at this time, it is necessary to control the distance sensors 11 corresponding to the overlapping target point 5 mutually uninfluential not to glare simultaneously. This is because the irradiation light irradiated from other distance sensors 11 by the irradiation light which must receive light essentially mixes and measurement of the distance of the target point 5 becomes difficult, when it irradiates with irradiation light simultaneous from two or more distance sensors 11.
[0037]
When the below-mentioned infrared distance sensor 30 (refer to drawing 5) is used for the distance sensors 11, The wavelength of the light flux which floodlights the infrared distance sensor 30 like the after-mentioned is made to differ for every sensor, It combines, and when it is made to pass the transmitted wave length zone corresponding to the beam floodlighted on the below-mentioned light-receiving lens 37 by coating or other means, even if the ****** target point 5 has lapped, it is not necessary to control not to glare simultaneously. The light source of the light flux which irradiates with the distance sensors 11 is blinked on fixed frequency different every distance sensors 30, It combines, and when it has the below-mentioned electric band pass filter which extracts only the signal of the frequency, even if the ****** target point 5 has lapped, it is not necessary to control not to glare simultaneously.
[0038]
Here, as shown in drawing 2 (b), control of an operation in case a glared type sensor is used for the distance sensors 11 and the target point 5 corresponding to two or more distance sensors 11 overlaps is explained. It is made to perform this control by the control section 21 of the below-mentioned control device 20. In the case of a glared type sensor, it controls after measurement of the distance of the one distance sensors 11 to measure the distance of the following distance sensors 11. That is, it controls so that two or more distance sensors 11 do not measure distance simultaneously. It is repeated until measurement of the distance of all the distance sensors 11 with which it had such operation is performed. This operation of a series of is made into one cycle, and time of one cycle is set to T.
[0039]
Every one distance by the distance sensors 11 is not measured as mentioned above, Distance can be made to measure simultaneously to two or more distance sensors 11 by what (for example, the target point 5 which measures distance simultaneously is carried out to every other one) is controlled not to measure the distance of the adjoining target point 5 simultaneously. If it does in this way, the time T of one cycle can be shortened substantially.
[0040]
An example of the composition of the monitoring instrument 1 is explained with reference to drawing 3. The monitoring instrument 1 is constituted including the case 10 in which two or more distance sensors 11 were installed, and the control device 20. The control devices 20 are a personal computer and a microcomputer typically. And it is connected to the control device 20, and two or more distance sensors 11 are constituted so that the distance information as an output of the distance sensors 11 may be outputted to the control device 20. Although distance information is an output value from the distance sensors 11 before actually computing distance, for example here, it is good also as the distance to a subject (sleeping person 2) itself. Hereafter, these are only called distance. Hereafter, distance explains an embodiment. Distance is good to constitute so that it may acquire from each distance sensors 11 serially. Although it is indicated as the figure middle distance sensor 11 and the control device 20 as a different body, it may constitute as one.

[0041]
By this embodiment, the distance sensors 11 are installed in the case 10 3x2 so that it may correspond to the target point 5 arranged 3x2 as drawing 2 explained.
[0042]
case 10' shown in the mimetic diagram of drawing 4 although the distance sensors 11 are typically installed in the case 10 in parallel -- a curve may be attached to the case 10 like. In this case, the distance sensors 11 are installed so that this curve may be met. By using such case 10', even if it miniaturizes, the large monitor area 50 is easily securable. Since case 10' can perform installing the distance sensor 11 easily so that the ****** target point 5 may not lap even if it is small, it can attain the miniaturization of a device.
[0043]
Here, the distance sensors 11 are explained further. As the distance sensors 11 to be used, there are infrared irradiation type distance sensors, an ultrasonic sensor, an electro magnetic pulse distance sensor, a passive type optical distance sensor, etc. Among these, infrared irradiation type distance sensors, an ultrasonic sensor, and an electro magnetic pulse distance sensor are glared type sensors (active type distance sensor). As for the distance sensors 11 to be used, it is preferred to use what that is used for an auto-focus camera is comparatively simple and cheap as mentioned above. The monitoring instrument 1 can consist of using such a distance sensor 11 simply and cheaply. Hereafter, the infrared distance sensor as an example of the distance sensors 11, an ultrasonic sensor, an electro magnetic pulse distance sensor, and a passive type optical distance sensor are explained with reference to figures.
[0044]
With reference to the block diagram of drawing 5, the distance sensors 30 (henceforth the infrared distance sensor 30) infrared irradiation type [as an example of the distance sensors 11] are explained. The infrared distance sensor 30 is what is called an active type optical sensor. The infrared distance sensor 30 is constituted including the infrared light irradiation part 31 as a Mitsuteru gunner stage which irradiates the sleeping person 2 with light flux, the infrared light light sensing portion 32b, and the sensor control part 33 that controls the infrared distance sensor 30 whole. It may be made to have the sensor control part 33 in the control section 21 of the control device 20 (refer to drawing 3).
[0045]
The infrared light irradiation part 31 is equipped with infrared LED34 and the irradiation lens 35, and it is irradiated with the light flux of the infrared light irradiated from infrared LED34 by the sleeping person 2 as a beam of a thin parallel pencil via the irradiation lens 35. If substantially parallel to a parallel pencil, it is good and light flux near in parallel is also included here. The infrared light light sensing portion 32 is provided with the following.
The light-receiving lens 37 as an image formation optical system which carries out image formation of the image of the optical irradiation pattern generated by the infrared light irradiation part 31 on the sleeping person 2.
The one-dimensional position detecting element 36 (henceforth PSD36) as a light-receiving means to be arranged near the image formation position with the light-receiving lens 37, and to receive the image formation pattern light by the image of the optical irradiation pattern which carried out image formation.

[0046]
The infrared distance sensor 30 has the position information outputting part 39 as a position information output unit constituted so that the image formation position information on the image formation pattern corresponding to the distance to the sleeping person 2 might be outputted based on the image formation position of the image formation pattern light by which image formation is carried out on PSD36. It has the position information outputting part 39 in the sensor control part

33. That is, based on the image formation position of the image formation pattern light by which image formation is carried out with the light-receiving lens 37, it is constituted so that the image formation position information on the image formation pattern as an output corresponding to said distance may be acquired by trigonometry. Here, light flux is a beam and the optical irradiation pattern by light flux is a beam spot. And image formation pattern light is a light which enters into PSD36 among the catoptric light from the sleeping person 2 of the beam spot generated on the sleeping person 2, and an image formation pattern is an image of the beam spot generated on the sleeping person 2 by whom image formation was done with the light-receiving lens 37. That is, an image formation pattern is an image of an approximate circle form here.

[0047]

Coating which makes only the light of the wavelength band region of the beam irradiated with the light-receiving lens 37 penetrate is performed. Therefore, the influence of disturbance light can carry out a detecting position few. Although light flux was made into the thin parallel pencil above, this is just a parallel pencil substantially and may be the light flux diffused or converged to some extent. In this case, the size of the pattern light on the below-mentioned PSD36 should just be a grade which is suitable and by which the supplement of a centroid position is not hindered.

[0048]

The wavelength of the beam which the infrared light irradiation part 31 floodlights may be made for the infrared distance sensors 30 to differ for every sensor. In this case, it combines and is made for the transmitted wave length zone of coating performed to the above-mentioned light-receiving lens 37 to also turn into a transmitted wave length zone corresponding to the beam to floodlight. It is not influenced by the beam of the next sensor, and even if it is a case where the ****** beam explained by drawing 2 (b) laps by this, since it is not necessary to control not to glare simultaneously, a monitoring instrument can be simplified. The infrared distance sensor 30 blinks infrared LED34 (light source) on fixed frequency, and it may be made to be provided with the electric band pass filter which extracts only the signal of the frequency to the infrared light light sensing portion 32. Thereby, the influence of disturbance light can be reduced. By changing this modulation frequency for every sensor, even when the beam explained by drawing 2 (b) laps, being influenced by the beam of the next sensor is lost. It is not necessary to control not to glare simultaneously by this, even if it is a case where a beam laps, and a monitoring instrument can be simplified. It is suitable even if it performs synchronous detection which makes it synchronize with the timing of an exposure of infrared LED34, and switches the polarity of the amplifier of the infrared light light sensing portion 32.

[0049]

With reference to drawing 6, PSD36 is explained further. Drawing 6 (a) is a schematic plan view, and drawing 6 (b) is a typical transverse-plane sectional view. As shown in drawing 6 (a), PSD36 has a larger acceptance surface product than an image formation pattern, and has the length which is a grade which is required ranging within the limits and an image formation pattern does not protrude in the move direction (left-in-the-figure right) of the image formation pattern by a distance change by movement of an image formation pattern.

[0050]

As shown in drawing 6 (b), PSD36 is constituted from the P layer 36a, the P layer 36a, and the I layer 36c that is in the middle of the N layer 36b, and the P layer 36a and the N layer 36b on the surface of an opposite hand by the surface of the side which receives the image formation pattern light of plate-like silicon. The image formation pattern by which image formation was carried out to PSD36 is changed into photoelectricity, and it is constituted so that a split output may be carried out, respectively from 36d of electrodes attached to the both ends of the P layer 36a as photoelectric current.

[0051]

Since the infrared distance sensor 30 outputs the centroid position of an image formation pattern as

image formation position information on an image formation pattern by calculating the output signal of the photoelectric current outputted from the both ends of PSD36 by the position information outputting part 39, it can measure the distance to the sleeping person 2 like the after-mentioned. The infrared distance sensor 30 is using infrared rays, and human being does not catch sight of it and it does not give displeasure to the beam with which it irradiates.

[0052]

The sensor control part 33 of the infrared distance sensor 30 becomes irregular in order to distinguish from disturbance light, when PSD36 detects the centroid position of an image formation pattern. Abnormal conditions are the operation which is performed by repeating the luminescence (exposure) stop of a beam periodically, for example. In this case, the luminescence stop of a beam may carry out the luminescence stop of the light source, for example, and may be made to carry out a luminescence stop by rotating a gobo and a slit. It may be made for abnormal conditions to also change the output of a beam by the strength of disturbance light furthermore in addition to ****. And the sensor control part 33 computes the output value which deducted the output value of PSD36 when not irradiating with the beam from the output value of PSD36 when irradiating with the beam. The sensor control part 33 makes modulation operation the center-of-gravity supplementary signal (henceforth a ranging signal) which is the image formation position information on an image formation pattern about a multiple-times deed and its average output value, in order to secure reliability. The sensor control part 33 is outputted to the control device 20 by making into distance the ranging signal value x which is a value of a ranging signal.

[0053]

As shown in the mimetic diagram of drawing 7, the distance value A to the target sleeping person 2 is computable with a following formula using trigonometry based on this ranging signal value x.

$A = f\,xw/(x-b)$ ...... (1)

When the light-receiving lens 37 of the infrared light light sensing portion 32 is used as a single lens, f the focal distance of the lens and w, In other words, the distance (base length) between the optic axes of the irradiation lens 35 and the light-receiving lens 37 and b indicate the distance between PSD36, and the bias value depending on arrangement of the photo detector of PSD36 to be infrared LED34. When using the combination lens generally used, let a focal distance here be a focal distance of the combination lens. When computing the above distance values A, it is good to compute the distance value A by the control section 21 of the control device 20.

[0054]

Although the case where the ranging signal value x was outputted as a distance was explained, above, the infrared distance sensor 30 may be constituted so that the distance value A itself computed by the above-mentioned method as a distance may be outputted.

[0055]

The ranging signal value x outputted from each infrared distance sensor 30 is changed by the influence of disturbance light still remaining slightly, although it becomes irregular as mentioned above. In order to absorb this change, the ranging signal value x acquired serially is averaged, and it is considered as the data at that time. The average value of the distance value A computed from the ranging signal value x may be sufficient as this data, and the depth L2 which is the average value of the height H2 or the depth L1 which is average value of the height H1 computed from the distance value A explained later may be sufficient as it. Although it thinks [that it is various and], the method of defining a fixed time interval beforehand, and equalizing data in the meantime, defining the number to equalize beforehand, and computing a moving average deviation serially may be sufficient as how to take an average. In the case of the former, there are few data numbers, and it ends, and is suitable for rough state grasp. In the case of the latter, although some data numbers increase, they can follow a fine action.

[0056]

Thus, since the infrared distance sensor 30 can be simply constituted from using PSD36, it can be

used as a cheap and simple monitoring instrument.

[0057]

With reference to the block diagram of drawing 8, the ultrasonic sensor 70 in an embodiment of the invention is explained. The ultrasonic sensor 70 is constituted including the ultrasonic transmission part 71 as an ultrasonic wave oscillator, the ultrasonic reception part 72 as an ultrasonic receiver, and the sensor control part 73. Furthermore in the sensor control part 73, it has the distance calculation section 74 which computes the distance to the sleeping person 2 by the time lag of transmission of the ultrasonic transmission part 71, and reception of the ultrasonic reception part 72. It may be made to have the sensor control part 73 in the control section 21 of the control device 20. Although the ultrasonic transmission part 71 and the ultrasonic reception part 72 considered it as the different body in this embodiment, they may be one. The distance to the sleeping person 2 computed by the distance calculation section 74 is good also as the time lag itself. This is because the distance to the sleeping person 2 is linearly found from a time lag, so change of a time lag can be regarded as change of distance as it is.

[0058]

A means to generate an ultrasonic wave in the ultrasonic transmission part 71 holds the material which has the piezo-electric effect, such as electrostrictive ceramics, with a metal plate etc. (vibrator), and by impressing a signal level, when a vibrator carries out flexing vibration, it generates an ultrasonic wave. A means to receive by the ultrasonic reception part 72 obtains electric generating power, when the reflected ultrasonic wave vibrates a vibrator. Therefore, in the case of an ultrasonic distance sensor, if an ultrasonic wave can be generated intermittently, the signal wave which has reflected and returned can be detected and a time lag can be detected by the origination side and a receiver, since acoustic velocity is known, the distance to the sleeping person 2 can be measured. In this case, although based also on signal processing after detection, the nearest reflection can be detected or an average distance of an irradiation area can be measured.

[0059]

With reference to the block diagram of drawing 9, the electro magnetic pulse distance sensor 80 in an embodiment of the invention is explained. The electro magnetic pulse distance sensor 80 is constituted including the electromagnetic wave transmission and reception section 81 and the sensor control part 82. The electromagnetic wave transmission and reception section 81 is constituted including an antenna, and performs oscillation of electromagnetic waves by which pulse modulation was carried out towards the sleeping person 2, and reception of the electromagnetic waves reflected by the sleeping person 2. Furthermore in the sensor control part 82, it has the distance calculation section 83 which computes the distance to the sleeping person 2 by the time lag of the oscillation of electromagnetic waves, and reception. It may be made to have the sensor control part 82 in the control section 21 of the control device 20. Although the electromagnetic wave transmission and reception section 81 considered it as one in this embodiment, it may constitute an electro magnetic pulse transmission section and an electromagnetic wave receive section in a different body. The distance to the sleeping person 2 is good also as the time lag itself like the above-mentioned ultrasonic sensor 70. Electromagnetic waves are about 10-GHz microwave typically.

[0060]

Since directivity becomes strong rather than an ultrasonic wave by using microwave for electromagnetic waves, the electro magnetic pulse distance sensor 80 can measure the target point 5 at pinpoint more. Since it will measure distance from what has returned in shortest time among the reflected electromagnetic waves if the electro magnetic pulse distance sensor 80 has the reflection from the part irradiated by the subject, it does not cause incorrect ranging by the image formation beam on PSD being missing, for example like an infrared distance sensor. Even if the electro magnetic pulse distance sensor 80 has contrast (for example, striped pattern) strong in an irradiation area, it is not influenced like an infrared distance sensor. The electro magnetic pulse

distance sensor 80 can be miniaturized easily.
The above infrared distance sensor 30, the ultrasonic sensor 70, and the electro magnetic pulse distance sensor 80 are glared type sensors.
[0061]
With reference to the block diagram of drawing 10, the passive type optical distance sensor 40 in an embodiment of the invention is explained. The passive type optical distance sensor 40 is constituted including the 1st light sensing portion 41 as an image formation device which receives the light from the sleeping person 2, the 2nd light sensing portion 42, and the sensor control part 43. To the 1st light sensing portion 41 and the 2nd light sensing portion 42, respectively The light-receiving lenses 44a and 44b, It has the 1st line CCD45 as one pair of image sensors, and the 2nd line CCD46, and image formation of the light from the sleeping person 2 is carried out to the 1st line CCD45 and the 2nd line CCD46 via the light-receiving lenses 44a and 44b, respectively. The light from the sleeping person 2 is catoptric light from the sleeping person 2 of the irradiation light currently typically irradiated by the sleeping person 2. In this case, irradiation light may be available light or may be artificial light.
[0062]
It may be made for the passive type optical distance sensor 40 to irradiate with the illumination light which has a specific intensity pattern to the monitor area 50 by an unillustrated illumination pattern light projection means, as shown in drawing 11. In this case, an illumination pattern avoids clear cyclic structures, in order that two or more below-mentioned correlation peak positions may come out. That is, it is good to use an aperiodic illumination pattern. An aperiodic illumination pattern is good to consider it as two or more aperiodic luminescent spots, for example like drawing 11 (a). It may be made for a luminescent spot to change each size. It is good also as the aperiodic singular number or two or more slit light like drawing 11 (b). It may be made for slit light to change each width. In this case, slit light is good for the base line direction of the distance sensors 11 like a graphic display to make it become vertical about. By doing in this way, it can prevent the below-mentioned correlative processing becoming inaccurate, also when the passive type optical distance sensor 40 has the low contrast within the target point 5 or the subject within the target point 5 has periodical structures (for example, striped pattern etc.), and exact measurement is possible.
[0063]
In the sensor control part 43, it has the correlation output calculation part 48 as a correlation output calculation device which computes the correlation output value of each output value of the 1st line CCD45 and 2nd line CCD46. It may be made to have the sensor control part 43 in the control section 21 of the control device 20. In the sensor control part 43, it is still better to have the difference image formation part 47 as a difference image forming device which forms the difference image of the picture which shifted time and was acquired about each of the 1st line CCD45 and 2nd line CCD46. Thereby, the sensor control part 43 can extract the image of the sleeping person 2 with a motion from the picture acquired from the 1st line CCD45 and the 2nd line CCD46. Although two pictures for forming a difference image shift and acquire time, the sleeping person's 2 movement magnitude does not become large too much, and should just make time to shift the about time of the grade it can be considered mostly substantially that is homotopic, for example, 0.1 second. Or it is considered as one to 10 of a television cycle cycle (1 / 30 - 1/3). If such a difference image is taken, the image of the sleeping person 2 for whom a background is removed and who has a motion can be extracted. The case where a difference image is used is explained in more detail later.
[0064]
A correlation output value is a relative image formation position difference generated with the azimuth difference of the 1st line CCD45 and 2nd line CCD46, and is a value typically outputted by correlative processing with a pixel number here. The sensor control part 43 computes distance with this correlation output value, i.e., the azimuth difference of the 1st line CCD45 and 2nd line CCD46

to trigonometry. Correlative processing is processing which computes by shifting one of the pictures acquired from the 1st line CCD45 and the 2nd line CCD46, respectively until two pictures are mostly in agreement, the quantity, for example, pixel number, which were shifted. A judgment of coincidence is made by the whole signal intensity. Signals are [peak ****** and time] identical features, i.e., a correlation peak position. The correlative processing by difference image formation binary-izes the difference image obtained from the 1st line CCD45 and the 2nd line CCD46, respectively with a proper value, and extracts an area part with a motion by extracting the edge part. Then, correlative processing is performed only in an extraction region. That is, the sleeping person's 2 distance can be found from a correlation output value. The 1st line CCD45 and the 2nd line CCD46 can be divided into two or more fields, by [corresponding] performing correlative processing the whole field, there are many backgrounds and a certain portion and subject can also be classified about.

[0065]

The passive type optical distance sensor 40 is a thing of a type which is adopted as the auto-focus camera, and detects the light-and-darkness state (difference in contrast) of the sleeping person's 2 surface using one pair of line CCD typically. The pixel to which one pair of line CCD corresponds identifies either by correlative processing, and measures distance by trigonometry. Its field angle is as narrow as about 10 degrees [full width], and line CCD generally used in the passive type optical distance sensor 40 needs comparatively many sensors, in order to cover the target point 5, but since it is not a glared type sensor, even if it operates the output from two or more sensors simultaneously, it is satisfactory at all. Therefore, it can process at high speed. Since the relative location on one pair of line CCD is compared as compared with the infrared distance sensor, there is also no influence by a beam being halfway missing, and there is an advantage which is stabilized and can acquire the distance of the target point 5.

[0066]

Here, the case where the difference image for clarifying distinction with the sleeping person 2 in the target point 5 and a background is used by the passive type optical distance sensor 40 is explained in detail.

[0067]

The picture which picturized the target point 5 is serially acquired from the 1st line CCD45 and the 2nd line CCD46 as an electric imaging signal. As for the picture acquired at time to differ from the 1st line CCD45 and the 2nd line CCD46, a difference image is formed of the difference image formation part 47 for every line CCD. A difference image is formed by the picture acquired in time to differ here in order to remove background parts from the acquired picture and to extract the sleeping person's 2 picture. By this, only the sleeping person 2 who moves will be extracted. A difference image is formed from the picture at the time of a short time, for example, 0.1 second, shifting. Since gaps of a picture are few, the sleeping person's 2 position hardly changes and it does not interfere with measurement of distance. However, a background is eliminated and can extract the sleeping person's 2 image.

[0068]

The difference image in which the sleeping person 2 was extracted can consider that the pixel whose grade which became ** from the dark from ** or dark by the sleeping person's 2 movement is comparatively big is the sleeping person's 2 boundary. And exact, it being stabilized and measuring can do distance which is the sleeping person 2 by performing correlative processing and measuring the sleeping person's 2 distance by trigonometry in the picture element region inside this boundary.

[0069]

Here, with reference to drawing 12, the calculating method of the distance A by the target point 5 which uses the passive type optical distance sensor 50 is explained. Here, when, as for w, the distance between line CCD (base length) and f use the light-receiving lens of line CCD as a single lens, the focal distance of the lens and d are the azimuth difference on the image formation face of

line CCD. When using the combination lens generally used, let a focal distance here be a focal distance of the combination lens. Thereby, the distance A by the target point 5 is computable with a following formula.
A = w x f/d ...... (2)
[0070]
As mentioned above, even if it uses which above-mentioned distance sensors as the distance sensors 11 of the monitoring instrument 1, the sleeping person's 2 distance is acquirable. That is, the sleeping person's 2 distance can be measured.
[0071]
It returns to drawing 3 and the monitoring instrument 1 is explained further. The control device 20 is provided with the control section 21, and is controlling the monitoring instrument 1 whole. It is connected to the control section 21 and two or more distance sensors 11 are controlled. The storage parts store 24 is connected to the control section 21, and the data of the information etc. which were computed can be memorized. In the storage parts store 24, it has the distance information preserving part 25 which saves the distance outputted from the distance sensors 11 by a time series. In the distance information preserving part 25, it is good to save the reference distance which is the distance by the target point 5 when the sleeping person 2 does not exist on the bed 6. Reference distance is saved with the same gestalt as the distance outputted from the distance sensors 11. The distance saved serially at the distance information preserving part 25 here is just the distance at the time of the past at the surveillance time, for example, may be the distance before acquired by one top.
[0072]
Furthermore in the storage parts store 24, it has the breathing pattern preserving part 26 which saves the sleeping person's 2 normal breathing pattern and unusual breathing pattern. The drawing 14 reference is carried out and a normal breathing pattern and an unusual breathing pattern are explained later.
[0073]
The output unit 28 which outputs the result processed with the input device 27 which inputs the information for operating the monitoring instrument 1, and the monitoring instrument 1 is connected to the control section 21. The input device 27 is a touch panel, a keyboard, or a mouse, and the output units 28 are a display and a printer. It may be built although the input device 27 and the output unit 28 are illustrated in this figure as what carries out external to the control device 20. The input device 27 of the switch and the output unit 28 which can perform a start and release of surveillance, for example is good also as LED as an operation indicator, for example. If it does in this way, the monitoring instrument 1 can be constituted simply.
[0074]
The control section 21 is equipped with the interface 29 for communicating with the exterior. It is constituted so that it can report outside, when it is judged that a state with the dangerous sleeping person 2 has the interface 29, for example by the detection processing part 23 of the control section 21. A report is based on the strength of the light which includes a sound, a character, a sign, and interior illumination, for example, or vibration. The interface 29 is provided with the function connected to communication lines, such as a general telephone line, an ISDN circuit, a PHS circuit, or a cellular-phone circuit. The control section 21 is provided with a voice response function, and it may be made to notify with a sound that a sleeping person is in a dangerous state to a third party via the interface 29.
[0075]
In the control section 21, it has the alarm equipment 90 constituted so that it might operate, when abnormalities occurred in the monitoring instrument 1. It is good to constitute so that it may operate, when it is judged that the alarm equipment 90 is in a state with the dangerous sleeping person 2, for example by the detection processing part 23 (i.e., when abnormalities, such as a case

where abnormalities occur in the sleeping person 2, and failure of the monitoring instrument 1, occur). Since it can respond promptly by doing in this way to the abnormalities caused in the sleeping person 2, reliability can be improved. The control device 20 is good to constitute via the interface 29, so that generating of abnormalities may be notified outside as mentioned above, when the alarm equipment 90 operates. Although the alarm equipment 90 is illustrated as external, it is good also as built-in in this figure.

[0076]

In the control section 21, it has the operation part 22 as an arithmetic unit which calculates the temporal change of the distance outputted from two or more distance sensors 11. The distance outputted from two or more distance sensors 11 is good also as the moving average deviation of the distance which carried out past fixed count acquisition, or was acquired within past fixed time, or period average rates. By doing in this way, the sudden noise by flicker of the daylight inserted from random noise or a window, etc. can be reduced, and incorrect judgment of the erroneous decision of a peak position and a zero cross position (intersection which numerals reverse) can be reduced.

[0077]

Calculating a temporal change is extracting the sleeping person's 2 shape change obtained by taking the difference of the distance acquired from the distance sensors 11, and the distance saved serially at the distance information preserving part 25 by acquiring distance from the distance sensors 11 with a certain time interval. This is extracting the sleeping person's 2 breathing, a body motion, and movement, for example. Thereby, the sleeping person's 2 extracted breathing forms a waveform pattern.

Drawing 13 is a figure showing the example of a waveform pattern.

[0078]

Furthermore in the control section 21, it has the detection processing part 23 as a detection processing device. The detection processing part 23 is constituted so that the sleeping person's 2 shape change may be detected based on the temporal change calculated by the operation part 22. That is, it is constituted so that the sleeping person's 2 breathing, a body motion, and movement may be detected. The detection processing part 23 may be constituted so that the sleeping person's 2 shape change may be detected based on the temporal change about one or more selected distance sensors 11 among two or more distance sensors 11.

[0079]

The detection processing part 23 is constituted so that the sleeping person's 2 condition may be judged based on both the cycle of the periodic change under detected shape change, and both [either or].

[0080]

Furthermore, by comparing the distance by the target point 5 with the reference distance saved at the distance information preserving part 25, the detection processing part 23 is constituted so that the sleeping person's 2 lying in bed may be detected. It may be made for the detection processing part 23 to choose the distance sensors 11 with the largest difference of the distance by the target point 5, and reference distance by this comparison. And it may be made to detect the sleeping person's 2 breathing, a body motion, and movement based on the temporal change about the selected distance sensors 11.

[0081]

After fixed time detection of the periodic change (the sleeping person's 2 breathing) under detected shape change is carried out, the detection processing part 23 may be constituted so that the sleeping person 2 may be in the monitor area 50, namely, may judge the sleeping person's 2 lying in bed. It may be made for the monitoring instrument 1 to start judgment of the sleeping person's 2 dangerous condition, on condition that the sleeping person's 2 lying in bed was judged. Fixed time is the time which is stabilized and can detect breathing, for example, is 30 to 90 seconds more preferably for 30 to 120 seconds.

[0082]
When the detection processing device 23 changes into the state where a periodic change is not detected and beyond fixed time can detect neither transitive change nor a periodic change after detecting the transitive change under detected shape change, It is good to constitute so that the supervisory object 2 might come out of the surveillance object field 50, namely, the sleeping person 2 may judge that bed leaving was carried out. Said fixed time is about 1 to 3 minutes, for example. For example, when the sleeping person 2 actually does bed leaving after detecting a body motion and movement, since it falls gradually, if it is looking only by variation, the value of a temporal change will have time to become a range which detects breathing, and will no longer be detected at all after that. For this reason, a judgment of bed leaving is made on the time of changing into the state where neither transitive change nor a periodic change is undetectable. However, since it means being in a quiet state after detecting a body motion or movement if breathing is detected before becoming such, if breathing, a body motion, and movement are lost after that, it must be judged that it is in a dangerous state.
[0083]
Based on the sleeping person's 2 detected continuous shape change, the detection processing device 23 may be constituted so that the cycle of a periodic change may be supervised. That is, based on breathing of the detected sleeping person 2, a body motion, and movement, the detection processing device 23 is constituted so that the cycle of breathing of the sleeping person 2 may be supervised. The detection processing part 23 is constituted so that the sleeping person's 2 shape change may be detected based on both the cycle of a periodic change, and both [either or]. The detection processing device 23 may be constituted so that a breathing rate may be supervised from the cycle of breathing. Here, it shall be contained in the concept to which supervising a breathing rate also supervises a cycle.
[0084]
In order to detect the shape change of the sleeping person 2 by the detection processing part 23, there are some methods and a typical example is shown below.
[0085]
As the 1st method of detecting the sleeping person's 2 shape change first, out of two or more distance sensors 11, the temporal change in the latest past fixed time chooses the greatest distance sensors 11, and the sleeping person's 2 shape change is detected based on the temporal change corresponding to the selected distance sensors 11. In this case, the method of choosing the distance sensors 11 with the largest change of a temporal change among the past about several times of the sleeping person's 2 breathing cycles (from several seconds to about about ten seconds) is effective as a method of choosing the distance sensors 11. How, as for this, reflection of breathing of the sleeping person 2 reflected in the temporal change corresponding to each target point 5 by the position of the target point 5 corresponding to each of two or more distance sensors 11, a body motion, and movement is carried out differs. For this reason, it is because it is effective to choose the distance sensors 11 corresponding to the temporal change which is reflecting it exactly in order for the detection processing part 23 to detect a minute change like breathing.
[0086]
Although it may change by the distance sensors' 11 selected in this way striking the sleeping person's 2 body motion, for example, changing sides, and moving, In such a case, after being in a quiet state, in fixed time, the distance sensors 11 with the largest change of a temporal change are chosen again, and a periodic change, i.e., breathing, comes to be detected. In this case, one cycle of the detected signal will correspond to 1 breathing. Since change of a far larger temporal change than breathing is detected while the sleeping person 2 is moving, it turns out that the sleeping person 2 is in a body motion state. This fixed time is time suitable for choosing the distance sensors 11 with the largest change of a temporal change, and, in other words, it is time until it is reflected in a temporal change that the sleeping person 2 changed into the quiet state. If this evaluates only the

amplitude of a periodic change, for example, it will be about 10 to 15 seconds more preferably several seconds (for example, 3 seconds) – about 20 seconds. If frequency analysis is conducted and a breathing rate is evaluated, it will be about 30 to 90 seconds. A quiet state is in the state where transitive change, i.e., a body motion, and movement are no longer detected. The state where transitive change is no longer detected so that it may explain in full detail by a 2nd embodiment, For example, if it judges that there was transitive change when a threshold was set up and a temporal change exceeded this threshold, and it is made to judge that it changed into the state where transitive change is no longer detected when less than this threshold and, it understands.
[0087]
A temporal change chooses the distance sensors beyond constant value, the periodic change of each selected temporal change is detected, and it may be made to evaluate the existence and the breathing rate of breathing from a periodic change with the clearest (breathing is expressed) periodicity.
[0088]
As the 2nd method of detecting the sleeping person's 2 shape change, the detection processing part 23 chooses two or more distance sensors 11 altogether, asks for total of the temporal change of the output of all selected these distance sensors 11, and detects the sleeping person's 2 shape change based on this total. Since this method detects the sleeping person's 2 shape change based on total of the temporal change of the distance outputted from all the distance sensors 11, it cannot be said to be not necessarily the most highly sensitive, but it is the simplest method and high speed processing can realize it easily. As total of the temporal change of distance, it is good also as total of the difference of the distance outputted from the distance sensors 11, and reference distance. In this case, one cycle of the detected signal will correspond to 1 breathing.
[0089]
As the 3rd method of detecting the sleeping person's 2 shape change, the detection processing part 23 chooses the temporal change in which an absolute value exceeds constant value, and detects the sleeping person's 2 shape change based on the average value of the selected temporal change. Since this method detects the sleeping person's 2 shape change based on the average value of the temporal change of distance, it can prevent thinning the sleeping person's 2 partial large motion on the whole, becoming a size near the movement toward breathing, and influencing detection of breathing of the sleeping person 2. In this case, one cycle of the detected signal will correspond to 1 breathing.
[0090]
As the 4th method of detecting the sleeping person's 2 shape change, the detection processing part 23 chooses the temporal change in which an absolute value exceeds constant value, and detects the sleeping person's 2 shape change based on the average value of the absolute value of the selected temporal change. Since this method detects the sleeping person's 2 shape change based on the average value of the absolute value of the temporal change of distance, For example, since it is integrated without offsetting each even if multiple selection of the temporal change of the distance in which an absolute value exceeds constant value is made and the temporal change of two or more selected distance has positive/negative, sensitivity becomes good to a small change like breathing. In this case, two cycles of the detected signal will correspond to 1 breathing.
[0091]
As the 5th method of detecting the sleeping person's 2 shape change, each phase of the temporal change about two or more selected distance sensors 11 is compared mutually, a phase carries out grouping of the near things of each by this comparison, and the detection processing part 23 asks for total of each group's temporal change. And each group's total is ****(ed) among the groups near an opposite phase. The detection processing part 23 detects the sleeping person's 2 shape change based on the value obtained from this ****. Since each phase of a temporal change carries out grouping of the near things of each and this method asks for total, the sleeping person's 2 breathing

is extracted as a group, and it can amplify it, for example. Since the sleeping person's 2 shape change is detected based on the value which ****(ed) each group's total and was obtained from **** among the groups still nearer to an opposite phase, For example, by the sleeping person's 2 breathing, even if there are a portion which goes up, and a falling portion, by ****(ing), breathing pattern amplitude can be made to be able to amplify and breathing can be detected certainly. In this case, one cycle of the detected signal will correspond to 1 breathing.

[0092]

As the 6th method of detecting the sleeping person's 2 shape change, The detection processing device 23 computes the frequency spectrum of all the outputs of two or more distance sensors 11, The sharpness of the peak of said computed frequency spectrum is beyond constant value, and said sharpness may choose the highest distance sensors 11, and based on the temporal change about said selected distance sensors 11, it may constitute so that the shape change of the supervisory object 2 may be detected.

[0093]

The value which did division of the height of a spectral peak with the integral value of the height of the spectrum of a perimeter wave number, and when discrete, the sharpness (acutance of image of a peak) of a peak, for example, For example, the value which did further division of the value which added height with the higher spectrum of the next door of a peak to the peak height by the sum of the height of the spectrum of a perimeter wave number can be made into an index. Since the distance sensors 11 which have detected the sleeping person's 2 breathing clearly can be chosen by evaluating that the sharpness of a peak is beyond constant value, it is easy to detect the sleeping person's 2 breathing.

[0094]

As the 7th method of detecting the sleeping person's 2 shape change, The detection processing device 23 computes the frequency spectrum of the output of the distance sensors 11 which have an absolute value of said temporal change in predetermined width, It is good for the sharpness of the peak of said computed frequency spectrum to be beyond constant value, and for said sharpness to choose the highest distance sensors 11, and to constitute based on the temporal change about said selected distance sensors 11, so that the shape change of the supervisory object 2 may be detected. In this method, it becomes easy to detect the sleeping person's 2 breathing to set width predetermined in the absolute value of a temporal change as the field to which the sleeping person's 2 breathing exists.

[0095]

As the 8th method of detecting the sleeping person's 2 shape change, The detection processing device 23 computes the frequency spectrum of the output of two or more distance sensors 11 from the one where the absolute value of said temporal change is larger, It is good for the sharpness of the peak of said computed frequency spectrum to be beyond constant value, and for said sharpness to choose the highest distance sensors 11, and to constitute based on the temporal change about said selected distance sensors 11, so that the shape change of the supervisory object 2 may be detected.

[0096]

The detection processing part 23 detects the sleeping person's 2 shape change using the above detecting methods. The monitoring instrument 1 judges the sleeping person's 2 condition based on the detected shape change. For example, when the cycle which a breathing pattern has for a short time is confused, or when the cycle which a breathing pattern has changes rapidly, it can be surmised that they are cerebrovascular disease, such as heart diseases, such as lung diseases, such as spontaneous pneumothorax and bronchial asthma, and congestive heart failure, or cerebral hemorrhage, for example. When disappearance of a breathing pattern continues, it can be surmised that the sleeping person's 2 breathing stopped. And when the body motion of the sleeping person 2 instead of a breathing pattern occurs frequently for a short time, a situation in which the sleeping

person 2 is troubled with a certain reason, and is rioting can be guessed.
[0097]
Since it changes sharply far compared with the case where only breathing is detected from a temporal change, detection of the sleeping person's 2 body motion or movement is easily detectable. In this case, the detection processing part 23 can also detect further whether the sleeping person 2 is moving rising whether it is moving by the spots, such as changing sides, for example, for example from a bed etc. from each temporal change corresponding to two or more distance sensors 11. Even when the sleeping person 2 does a periodic and small motion like a convulsion, abnormalities can be detected from the waveform pattern. It is also detectable with the state where the sleeping person 2 is twitching, by saving the waveform pattern in the state where it is twitching at the storage parts store 24.
[0098]
With reference to drawing 14, the example of a normal and unusual breathing pattern is explained. The normal breathing pattern saved at the breathing pattern preserving part 26 in the storage parts store 24 is a periodic pattern as shown in drawing 14 (a). However, the range normal as a breathing rate for 1 minute in the case of an adult is about 10 to 20 times. The unusual breathing pattern saved at the breathing pattern preserving part 26, For example, it is the breathing pattern considered to produce chain stokes (Cheyne-Stokes) breathing, central hyperventilation, ataxic breathing, large breathing of dregs MAURU (Kussmul), etc. when the obstacle has occurred inside of the body physiologically.
[0099]
The breathing pattern of central hyperventilation is shown in drawing 14 (c), and the breathing pattern of ataxic breathing is shown for the breathing pattern of Cheyne-Stokes breathing in drawing 14 (b) at drawing 14 (d), respectively.
Furthermore, the name of a disease or the disease part at the time of being generated by the above-mentioned unusual breathing pattern is shown in drawing 15.
[0100]
The detection processing part 23 distinguishes whether the sleeping person's 2 breathing pattern belongs to which breathing pattern using the frequency of breathing of each breathing pattern and appearance frequency differing from sounding, and judges the sleeping person's 2 condition.
[0101]
Furthermore, when it judges with belonging to the breathing pattern considered that the sleeping person's 2 breathing produces the detection processing part 23 in **** which the obstacle has generated inside of the body physiologically, if the sleeping person 2 is doing unusual breathing and is in a dangerous state, it will detect. The sleeping person's 2 condition detected in this way is outputted by the control section 21 from the output unit 28. The contents outputted are the name of a disease, a disease organ, a disease part, etc. which are considered when it comes to the sleeping person's 2 detected breathing rate, the frequency of a motion, and the name of an unusual breathing pattern and the cause of the breathing.
[0102]
Above, in two or more case, it explained, but the number of the distance sensors 11 may be one, and in that case, they can simplify the monitoring instrument 1 and can miniaturize it. Since the number of the outputs from the distance sensors 11 to process decreases, the high speed processing of the monitoring instrument 1 is possible.
[0103]
According to a 1st above embodiment, the sleeping person's 2 breathing can be detected certainly and the sleeping person's 2 condition can be judged. And since image processing using the camera which is mentally uncomfortable is not used, high speed processing is possible with a simple device. When elderly people and a sick person fall into critical condition, a prompt emergency action is possible.

[0104]
[Effect of the Invention]
Two or more distance sensors which are installed towards a different position in a surveillance object field, and measure the distance to a supervisory object according to this invention as mentioned above and which became independent respectively, An arithmetic unit which calculates the temporal change of each output of two or more of said distance sensors, When it has a detection processing device which detects the shape change of said supervisory object based on said calculated temporal change about one or more selected distance sensors among said two or more distance sensors, It not only can detect the state of a supervisory object certainly, but it can provide a small and simple monitoring instrument.
[Brief Description of the Drawings]
[Drawing 1]It is a typical perspective view showing the outline of the monitoring instrument which is an embodiment of the invention.
[Drawing 2]It is a schematic plan view explaining the example of arrangement (b) with which the example of arrangement of the target point which is an embodiment of the invention (a), and a target point overlap.
[Drawing 3]It is a block diagram showing the example of composition of the monitoring instrument used by an embodiment of the invention.
[Drawing 4]It is a typical side view explaining the case where attach a curve and the distance sensors which are embodiments of the invention are installed.
[Drawing 5]It is a block diagram showing the example of composition of the infrared distance sensor used by an embodiment of the invention.
[Drawing 6]They are the (a) schematic plan view explaining PSD in the case of drawing 5, and (b) typical transverse-plane sectional view.
[Drawing 7]It is a mimetic diagram which illustrates how to compute the distance of a supervisory object by an embodiment of the invention.
[Drawing 8]It is a block diagram showing the example of composition of the ultrasonic sensor used by an embodiment of the invention.
[Drawing 9]It is a block diagram showing the example of composition of the electro magnetic pulse distance sensor used by an embodiment of the invention.
[Drawing 10]It is a block diagram showing the example of composition of the passive type optical distance sensor used by an embodiment of the invention.
[Drawing 11]It is a schematic diagram showing the illumination pattern in the case of drawing 10.
[Drawing 12]It is a mimetic diagram which illustrates how to compute the distance of a supervisory object from the azimuth difference of one pair of line CCD in the case of drawing 10.
[Drawing 13]It is a schematic diagram which is used by an embodiment of the invention and in which showing the waveform pattern of breathing.
[Drawing 14]It is a schematic diagram showing the waveform pattern of normal and unusual breathing in the case of drawing 13.
[Drawing 15]It is a figure showing the table of the name of a disease corresponding to the waveform pattern of unusual breathing in the case of drawing 14, or a disease part.
[Description of Notations]
1 Monitoring instrument
2 Sleeping person
3 Bedding
4 Stand
5 Target point
6 Bed
10 Case
11 Distance sensors

20 Control device
21 Control section
22 Operation part
23 Detection processing part
24 Storage parts store
25 Distance information preserving part
26 Breathing pattern preserving part
27 Input device
28 Output unit
29 Interface
30 Infrared distance sensor
31 Infrared light irradiation part
32 Infrared light light sensing portion
40 Passive type optical distance sensor
41 The 1st light sensing portion
42 The 2nd light sensing portion
47 Difference image formation part
48 Correlation output calculation part
50 Monitor area
70 Ultrasonic sensor
80 Electro magnetic pulse distance sensor

[Translation done.]

TECHNICAL FIELD

[Field of the Invention]
This invention relates to the monitoring instrument for supervising change of breathing of a sleeping person etc. especially about the monitoring instrument which supervises a supervisory object.
[0002]

[Translation done.]

PRIOR ART

[Description of the Prior Art]
The device which supervises change of breathing of a sleeping person from the former as a monitoring instrument which supervises change of breathing of a sleeping person based on time transition of the pressure distribution detected with the load sensor or the pressure sensor is proposed.
[0003]

[Translation done.]

EFFECT OF THE INVENTION

[Effect of the Invention]
Two or more distance sensors which are installed towards a different position in a surveillance object field, and measure the distance to a supervisory object according to this invention as mentioned above and which became independent respectively, An arithmetic unit which calculates the temporal change of each output of two or more of said distance sensors, When it has a detection processing device which detects the shape change of said supervisory object based on said calculated temporal change about one or more selected distance sensors among said two or more distance sensors, It not only can detect the state of a supervisory object certainly, but it can provide a small and simple monitoring instrument.

[Translation done.]

TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention]
However, in order to acquire and detect the stable signal from the signal of a monitoring instrument measured being minute according to the above conventional devices, it became a highly efficient signal amplifier and a certain signal processing are required, and complicated as a system, and large-scale.
[0004]
Then, it not only detects the state of a supervisory object certainly, but an object of this invention is to provide a small and simple monitoring instrument.
[0005]

[Translation done.]

MEANS

[Means for Solving the Problem]
To achieve the above objects, a monitoring instrument by invention concerning claim 1, For example, as shown in drawing 1 and drawing 3, it is installed towards a different position in the surveillance object field 50, Two or more distance sensors 11 which measure distance to a supervisory object and which became independent respectively, and the arithmetic unit 22 which calculates a temporal change of each output of the distance sensors 11 of; plurality; out of two or more distance sensors 11. A temporal change in the latest past fixed time chooses the greatest distance sensors 11, Based on a temporal change corresponding to said selected distance sensors 11, have the detection processing device 23 which detects a shape change of the supervisory object 2, and; detection processing device 23, After the supervisory object 2 is in a quiet state, a temporal change in the latest fixed time chooses the greatest distance sensors 11, and when transitive change of the supervisory object 2 is detected, based on the temporal change, it is constituted so that a shape change of the supervisory object 2 may be detected.
[0006]
Since it will have two or more distance sensors 11 which became independent respectively, and the arithmetic unit 22 which calculates a temporal change of outputs of two or more distance sensors 11 if constituted in this way, a temporal change of distance to a supervisory object can be obtained, for example. Out of two or more distance sensors 11, a temporal change in the latest past fixed time chooses the greatest distance sensors 11, and a shape change of the supervisory object 2 is detected based on a temporal change corresponding to said selected distance sensors 11, Since a temporal change in the latest fixed time chooses the greatest distance sensors 11 and a shape change of the supervisory object 2 is detected based on the temporal change after the supervisory object 2 is in a quiet state when transitive change of the supervisory object 2 is detected, a sleeping person's breathing is detectable, for example. Thereby, it not only can detect a sleeping person's condition certainly, but it can provide a small and simple monitoring instrument.
[0007]
To achieve the above objects, a monitoring instrument by invention concerning claim 2, For example, as shown in drawing 1 and drawing 3, it is installed towards a different position in the surveillance object field 50, . Measure distance to the supervisory object 2. Two or more distance sensors 11 which became independent respectively, and the arithmetic unit 22 which calculates a temporal change of each output of the distance sensors 11 of; plurality; Based on said calculated temporal change about one or more selected distance sensors 11, among two or more distance sensors 11, a shape change of the supervisory object 2. It has the detection processing device 23 to detect, and; detection processing device 23 chooses two or more distance sensors 11 altogether, asks for total of a temporal change of an output of said selected distance sensors 11, and based on this total, it is constituted so that a shape change of said supervisory object 2 may be detected.
[0008]

Since it has two or more distance sensors 11, arithmetic units 22, and detection processing devices 23 if constituted in this way, based on said calculated temporal change about one or more selected distance sensors 11, a shape change of the supervisory object 2 is detectable among two or more distance sensors 11. Since the detection processing device 23 chooses two or more distance sensors 11 altogether, asks for total of a temporal change of an output of said selected distance sensors 11, and it is constituted based on this total so that a shape change of said supervisory object 2 may be detected, high speed processing is possible for it, for example. Thereby, it not only can detect a sleeping person's condition certainly, but it can provide a small and simple monitoring instrument.

[0009]

To achieve the above objects, a monitoring instrument by invention concerning claim 3, For example, as shown in drawing 1 and drawing 3, it is installed towards a different position in the surveillance object field 50, . Measure distance to the supervisory object 2. Two or more distance sensors 11 which became independent respectively, and the arithmetic unit 22 which calculates a temporal change of each output of the distance sensors 11 of; plurality; Based on said calculated temporal change about one or more selected distance sensors 11, among two or more distance sensors 11, a shape change of the supervisory object 2. Have the detection processing device 23 to detect and; detection processing device 23, Frequency spectrum of all the outputs of two or more distance sensors 11 is computed, Sharpness of a peak of said computed frequency spectrum is beyond constant value, and said sharpness chooses the highest distance sensors 11, and based on a temporal change about said selected distance sensors, it is constituted so that a shape change of the supervisory object 2 may be detected.

[0010]

Since it has two or more distance sensors 11, arithmetic units 22, and detection processing devices 23 if constituted in this way, based on said calculated temporal change about one or more selected distance sensors 11, a shape change of the supervisory object 2 is detectable among two or more distance sensors 11. The detection processing device 23 computes frequency spectrum of all the outputs of two or more distance sensors 11, Sharpness of a peak of said computed frequency spectrum is beyond constant value, And since it is constituted so that said sharpness may choose the highest distance sensors 11 and may detect a shape change of the supervisory object 2 based on a temporal change about said selected distance sensors, a sleeping person's breathing is certainly detectable, for example. Thereby, it not only can detect a sleeping person's condition certainly, but it can provide a small and simple monitoring instrument.

[0011]

To achieve the above objects, a monitoring instrument by invention concerning claim 4, For example, as shown in drawing 1 and drawing 3, it is installed towards a different position in the surveillance object field 50, . Measure distance to the supervisory object 2. Two or more distance sensors 11 which became independent respectively, and the arithmetic unit 22 which calculates a temporal change of each output of the distance sensors 11 of; plurality; Based on said calculated temporal change about one or more selected distance sensors 11, among two or more distance sensors 11, a shape change of the supervisory object 2. Have the detection processing device 23 to detect and; detection processing device 23, Frequency spectrum of an output of the distance sensors 11 which have an absolute value of said temporal change in predetermined width is computed, Sharpness of a peak of said computed frequency spectrum is beyond constant value, and said sharpness chooses the highest distance sensors 11, and based on a temporal change about said selected distance sensors 11, it is constituted so that a shape change of the supervisory object 2 may be detected.

[0012]

Since it has two or more distance sensors 11, arithmetic units 22, and detection processing devices 23 if constituted in this way, based on said calculated temporal change about one or more selected distance sensors 11, a shape change of the supervisory object 2 is detectable among two or more

distance sensors 11. The detection processing device 23 computes frequency spectrum of an output of the distance sensors 11 which have an absolute value of said temporal change in predetermined width, Sharpness of a peak of said computed frequency spectrum is beyond constant value, And since it is constituted so that said sharpness may choose the highest distance sensors 11 and may detect a shape change of the supervisory object 2 based on a temporal change about said selected distance sensors 11, a sleeping person's breathing is certainly detectable, for example. Thereby, it not only can detect a sleeping person's condition certainly, but it can provide a small and simple monitoring instrument.

[0013]

To achieve the above objects, a monitoring instrument by invention concerning claim 5, For example, as shown in drawing 1 and drawing 3, it is installed towards a different position in the surveillance object field 50, . Measure distance to the supervisory object 2. Two or more distance sensors 11 which became independent respectively, and the arithmetic unit 22 which calculates a temporal change of each output of the distance sensors 11 of; plurality; Based on said calculated temporal change about one or more selected distance sensors 11, among two or more distance sensors 11, a shape change of the supervisory object 2. Have the detection processing device 23 to detect and; detection processing device 23, Frequency spectrum of an output of two or more distance sensors 11 is computed from the one where an absolute value of said temporal change is larger, Sharpness of a peak of said computed frequency spectrum is beyond constant value, and said sharpness chooses the highest distance sensors 11, and based on a temporal change about said selected distance sensors 11, it is constituted so that a shape change of the supervisory object 2 may be detected.

[0014]

Since it has two or more distance sensors 11, arithmetic units 22, and detection processing devices 23 if constituted in this way, based on said calculated temporal change about one or more selected distance sensors 11, a shape change of the supervisory object 2 is detectable among two or more distance sensors 11. The detection processing device 23 computes frequency spectrum of an output of two or more distance sensors 11 from the one where an absolute value of said temporal change is larger, Sharpness of a peak of said computed frequency spectrum is beyond constant value, And since it is constituted so that said sharpness may choose the highest distance sensors 11 and may detect a shape change of the supervisory object 2 based on a temporal change about said selected distance sensors 11, a sleeping person's breathing is certainly detectable, for example. Thereby, it not only can detect a sleeping person's condition certainly, but it can provide a small and simple monitoring instrument.

[0015]

To achieve the above objects, a monitoring instrument by invention concerning claim 6, For example, as shown in drawing 1 and drawing 3, it is installed towards a different position in the surveillance object field 50, . Measure distance to the supervisory object 2. Two or more distance sensors 11 which became independent respectively, and the arithmetic unit 22 which calculates a temporal change of each output of the distance sensors 11 of; plurality; Based on said calculated temporal change about one or more selected distance sensors 11, among two or more distance sensors 11, a shape change of the supervisory object 2. It has the detection processing device 23 to detect, and an absolute value of said temporal change chooses the distance sensors 11 exceeding constant value, and based on average value of a temporal change about said selected distance sensors 11,; detection processing device 23 is constituted so that a shape change of the supervisory object 2 may be detected.

[0016]

Since it has two or more distance sensors 11, arithmetic units 22, and detection processing devices 23 if constituted in this way, based on said calculated temporal change about one or more selected distance sensors 11, a shape change of the supervisory object 2 is detectable among two or more

distance sensors 11. Since the detection processing device 23 chooses distance sensors with which an absolute value of a temporal change exceeds constant value, and it is constituted based on average value of a temporal change about selected distance sensors so that a shape change of the supervisory object 2 may be detected, it can detect a sleeping person's breathing certainly, for example. Thereby, it not only can detect a sleeping person's condition certainly, but it can provide a small and simple monitoring instrument.

[0017]

To achieve the above objects, a monitoring instrument by invention concerning claim 7, For example, as shown in drawing 1 and drawing 3, it is installed towards a different position in the surveillance object field 50, . Measure distance to the supervisory object 2. Two or more distance sensors 11 which became independent respectively, and the arithmetic unit 22 which calculates a temporal change of each output of the distance sensors 11 of; plurality; Based on said calculated temporal change about one or more selected distance sensors 11, among two or more distance sensors 11, a shape change of the supervisory object 2. It has the detection processing device 23 to detect, and an absolute value of said temporal change chooses the distance sensors 11 exceeding constant value, and based on average value of an absolute value of a temporal change about said selected distance sensors 11,; detection processing device 23 is constituted so that a shape change of the supervisory object 2 may be detected.

[0018]

Since it has two or more distance sensors 11, arithmetic units 22, and detection processing devices 23 if constituted in this way, based on said calculated temporal change about one or more selected distance sensors 11, a shape change of the supervisory object 2 is detectable among two or more distance sensors 11. Since the detection processing device 23 chooses distance sensors with which an absolute value of a temporal change exceeds constant value, and it is constituted based on average value of an absolute value of a temporal change about selected distance sensors so that a shape change of the supervisory object 2 may be detected, it can detect a sleeping person's breathing certainly, for example. Thereby, it not only can detect a sleeping person's condition certainly, but it can provide a small and simple monitoring instrument.

[0019]

To achieve the above objects, a monitoring instrument by invention concerning claim 8, For example, as shown in drawing 1 and drawing 3, it is installed towards a different position in the surveillance object field 50, . Measure distance to a supervisory object. Two or more distance sensors 11 which became independent respectively, and the arithmetic unit 22 which calculates a temporal change of each output of the distance sensors 11 of; plurality; Based on said calculated temporal change about one or more selected distance sensors 11, among two or more distance sensors 11, a shape change of the supervisory object 2. Have the detection processing device 23 to detect and; detection processing device 23, Compare mutually each phase of said temporal change about the selected distance sensors 11 of said plurality, and said phase carries out grouping of the near things of each by said comparison, ask for total of each of said group's temporal change, and among groups near an opposite phase, Said said a group's total of each is ****(ed), and based on a value obtained from the aforementioned difference **, it is constituted so that a shape change of the supervisory object 2 may be detected.

[0020]

Since it has two or more distance sensors 11, arithmetic units 22, and detection processing devices 23 if constituted in this way, based on said calculated temporal change about one or more selected distance sensors 11, a shape change of the supervisory object 2 is detectable among two or more distance sensors 11. The detection processing device 23 compares mutually each phase of said temporal change about the selected distance sensors 11 of said plurality, and said phase carries out grouping of the near things of each by said comparison, It asks for total of each of said group's temporal change, and said said a group's total of each is ****(ed) among groups near an opposite

phase, and since it is constituted based on a value obtained from the aforementioned difference ** so that a shape change of the supervisory object 2 may be detected, a sleeping person's breathing is certainly detectable, for example. Thereby, it not only can detect a sleeping person's condition certainly, but it can provide a small and simple monitoring instrument.

[0021]

Like a statement to claim 9, the detection processing device 23 is good in the monitoring instrument 1 given in any 1 paragraph of claim 1 thru/or claim 8 to constitute so that a state of the supervisory object 2 may be judged based on both a cycle of a periodic change under said detected shape change, and both [either or].

[0022]

It is [like] good to constitute from the monitoring instrument 1 given in any 1 paragraph of claim 1 thru/or claim 9 so that it may judge that the detection processing device 23 has the supervisory object 2 in the surveillance object field 50 when [according to claim 10] a periodic change under said detected shape change continues beyond in fixed time.

[0023]

Since it is constituted so that it may judge that the supervisory object 2 is in the surveillance object field 50 when a periodic change under said detected shape change continues beyond in fixed time if constituted in this way, a sleeping person's lying in bed is detectable, for example.

[0024]

In the above monitoring instrument 1, the detection processing device 23, When it changes into the state where a periodic change is not detected and beyond fixed time can detect neither transitive change nor a periodic change after detecting transitive change under said detected shape change, it is good to constitute so that it may judge that the supervisory object 2 came out of the surveillance object field 50. If constituted in this way, a sleeping person's bed leaving can be judged, for example.

[0025]

To claim 11, like a statement in the monitoring instrument 1 of a statement, in any 1 paragraph of claim 1 thru/or claim 10. For example, as shown in drawing 5, the distance sensors 30, It has the Mitsuteru gunner stage 31 which irradiates the supervisory object 2 with light flux, and the image formation optical system 37 which carries out image formation of the image of an optical irradiation pattern generated by the Mitsuteru gunner stage 31 on the supervisory object 2, It is good to constitute based on an image formation position of image formation pattern light in which image formation is carried out by the image formation optical system 37, so that an output corresponding to said distance may be obtained by trigonometry.

[0026]

The Mitsuteru gunner stage 31 to which the distance sensors 30 will irradiate the supervisory object 2 with light flux if constituted in this way, It has the image formation optical system 37 which carries out image formation of the image of an optical irradiation pattern generated by the Mitsuteru gunner stage 31 on the supervisory object 2, Since it is constituted based on an image formation position of image formation pattern light in which image formation is carried out by the image formation optical system 37 so that an output corresponding to said distance may be obtained by trigonometry, it can be considered as the cheap and simple monitoring instrument 1.

[0027]

To claim 12, like a statement in the monitoring instrument 1 of a statement, in any 1 paragraph of claim 1 thru/or claim 10. For example, based on information on the two or more image formation devices 41 and 42 which carry out image formation of the supervisory object 2 with an individual optic axis, and an image formation position from the image formation devices 41 and 42, as shown in drawing 10, the distance sensors 40 may be constituted so that an output corresponding to said distance may be obtained by trigonometry.

[0028]

The two or more image formation devices 41 and 42 to which the distance sensors 40 will carry out image formation of the supervisory object 2 with an individual optic axis if constituted in this way, Since it is constituted based on information on an image formation position from the image formation devices 41 and 42 so that an output corresponding to said distance may be obtained by trigonometry, it can be considered as the cheap and simple monitoring instrument 1.
[0029]
To achieve the above objects, a monitoring instrument by this invention, For example, as shown in drawing 1 and drawing 3, it is installed towards inside of the surveillance object field 50, The distance sensors 11 which measure distance to the supervisory object 2, and the arithmetic unit 22 which calculates a temporal change of an output of the; distance sensors 11; Have the detection processing device 23 which detects a shape change of the supervisory object 2 based on said calculated temporal change, and; detection processing device 23, When a periodic change under said detected shape change continues beyond in fixed time, it may be constituted so that it may judge that the supervisory object 2 is in the surveillance object field 50.
[0030]
Since it has the distance sensors 11, the arithmetic unit 22, and the detection processing device 23 if constituted in this way, a temporal change of an output of the distance sensors 11 can be calculated, and a shape change of the supervisory object 2 can be detected based on said calculated temporal change. Since it is constituted so that it may judge that the detection processing device 23 has the supervisory object 2 in the surveillance object field 50 when a periodic change under said detected shape change continues beyond in fixed time, a sleeping person's breathing and lying in bed are detectable, for example. It can constitute simply. Thereby, it not only can detect a sleeping person's condition certainly, but it can provide a small and simple monitoring instrument.
[0031]
[Embodiment of the Invention]
Hereafter, an embodiment of the invention is described with reference to drawings. Identical codes or similar numerals are given to the member which is mutually the same or corresponds in each figure, and the duplicate explanation is omitted.
[0032]
Drawing 1 is a typical perspective view of the monitoring instrument 1 which is an embodiment by this invention. The sleeping person 2 as a thing which is a supervisory object and carries out a periodic change to the bed 6 upper surface (henceforth the monitor area 50) as a surveillance object field in a figure lies and exists. On the sleeping person 2, the bedding 3 is covered further, and some sleeping persons 2 and some beds 6 are covered. That is, the monitoring instrument 1 is supervising the upper surface of the bedding 3. The bedding 3 is not used but it may be made for the monitoring instrument 1 to supervise the sleeping person's 2 idiosoma itself. In this embodiment, a shape change is a successive change and a successive change is a concept including a periodic change and transitive change. The sleeping person's 2 shape changes are the sleeping person's 2 periodic change, and transitive change, for example. The sleeping person's 2 periodic change is the sleeping person's 2 breathing, for example. The sleeping person's 2 transitive change is the sleeping person's 2 body motion, and movement, for example. A periodic change is the cycle of breathing of a person (sleeping person), for example, change of per minute five to 60 cycle, for example. That is, according to this embodiment, a periodic change does not include the periodic change from which it separated greatly from the cycle of breathing. By the way, although a grown-up breathing rate is in about per minute 5 to 30 times of ranges, in the case of a small child, there is a tendency for a breathing rate to increase further.
[0033]
Based on the sleeping person's 2 detected shape change, the monitoring instrument 1 is constituted so that the sleeping person's 2 condition may be judged. The sleeping person's 2 condition is in

movement, for example, the implantation, and the state where it carries out bed leaving etc. which are carrying out normal breathing, for example and which are carrying out unusual breathing and have struck, dangerous body motion, for example, changing sides.

[0034]

On the other hand, the case 10 constituted including two or more distance sensors 11 which measure the distance to the sleeping person 2 who exists in the monitor area 50 is installed in the stand 4 in a figure. Two or more distance sensors 11 are installed in the case 10 corresponding to two or more surveillance object points (henceforth a target point). According to this embodiment, although the case 10 (distance sensors 11) is installed in the stand 4, when a wall and a ceiling exist, a wall and a ceiling may be sufficient as it and a setting position may determine it suitably with the purpose, specification, etc. of a monitoring instrument. The stand 4 is movable and makes installation of the case 10 easy. As for the distance sensors 11, it is preferred to arrange two or more rows to the case 10.

[0035]

With reference to the example of arrangement of the target point of the schematic plan view of drawing 2, a target point is suitably explained with reference to drawing 1. As shown in drawing 2 (a), two or more target points corresponding to two or more distance sensors 11 are arranged so that each target point may not lap with a ****** target point. In this case, for example like a graphic display, two or more target points are arranged in a grid pattern so that the target points 51, 52, 53, 54, 55, and 56 (it is only called the target point 5 when not distinguishing a target point below) may not lap with the monitor area 50 mutually. As for two or more target points 5, it is preferred to set it as the range which covers the position of the sleeping person 2 on the bed 6 (under the bedding 3) which can be about taken while an abdomen, a thorax, regions of back, and a shoulder go to bed. In this embodiment, although the number to arrange is two rows (it expresses the following 3x2) of three lines, it may be suitably decided by the conditions of the place to supervise, the sleeping person 2, etc., for example, 3x3 and 4x4 may be sufficient as it. Thus, even when two or more target points 5 were arranged and the glared type sensor which measures distance by irradiating the distance sensors 11 with light or an ultrasonic wave is used, It is not necessary to control the distance sensors 11 corresponding to the adjoining target point 5 not to glare simultaneously like the after-mentioned, and they can consider the monitoring instrument 1 as easier composition.

[0036]

As shown in the example of arrangement of the target point 5 of the schematic plan view of drawing 2 (b), the ****** target point 5 may lap. Since the dead angle in the monitor area 50 can be lessened if it does in this way, it is effective in higher-precision surveillance. To use the glared type sensor which measures distance by irradiating the distance sensors 11 with light or an ultrasonic wave at this time, it is necessary to control the distance sensors 11 corresponding to the overlapping target point 5 mutually uninfluential not to glare simultaneously. This is because the irradiation light irradiated from other distance sensors 11 by the irradiation light which must receive light essentially mixes and measurement of the distance of the target point 5 becomes difficult, when it irradiates with irradiation light simultaneous from two or more distance sensors 11.

[0037]

When the below-mentioned infrared distance sensor 30 (refer to drawing 5) is used for the distance sensors 11, The wavelength of the light flux which floodlights the infrared distance sensor 30 like the after-mentioned is made to differ for every sensor, It combines, and when it is made to pass the transmitted wave length zone corresponding to the beam floodlighted on the below-mentioned light-receiving lens 37 by coating or other means, even if the ****** target point 5 has lapped, it is not necessary to control not to glare simultaneously. The light source of the light flux which irradiates with the distance sensors 11 is blinked on fixed frequency different every distance sensors 30, It combines, and when it has the below-mentioned electric band pass filter which extracts only the signal of the frequency, even if the ****** target point 5 has lapped, it is not necessary to control

not to glare simultaneously.

[0038]

Here, as shown in drawing 2 (b), control of an operation in case a glared type sensor is used for the distance sensors 11 and the target point 5 corresponding to two or more distance sensors 11 overlaps is explained. It is made to perform this control by the control section 21 of the below-mentioned control device 20. In the case of a glared type sensor, it controls after measurement of the distance of the one distance sensors 11 to measure the distance of the following distance sensors 11. That is, it controls so that two or more distance sensors 11 do not measure distance simultaneously. It is repeated until measurement of the distance of all the distance sensors 11 with which it had such operation is performed. This operation of a series of is made into one cycle, and time of one cycle is set to T.

[0039]

Every one distance by the distance sensors 11 is not measured as mentioned above, Distance can be made to measure simultaneously to two or more distance sensors 11 by what (for example, the target point 5 which measures distance simultaneously is carried out to every other one) is controlled not to measure the distance of the adjoining target point 5 simultaneously. If it does in this way, the time T of one cycle can be shortened substantially.

[0040]

An example of the composition of the monitoring instrument 1 is explained with reference to drawing 3. The monitoring instrument 1 is constituted including the case 10 in which two or more distance sensors 11 were installed, and the control device 20. The control devices 20 are a personal computer and a microcomputer typically. And it is connected to the control device 20, and two or more distance sensors 11 are constituted so that the distance information as an output of the distance sensors 11 may be outputted to the control device 20. Although distance information is an output value from the distance sensors 11 before actually computing distance, for example here, it is good also as the distance to a subject (sleeping person 2) itself. Hereafter, these are only called distance. Hereafter, distance explains an embodiment. Distance is good to constitute so that it may acquire from each distance sensors 11 serially. Although it is indicated as the figure middle distance sensor 11 and the control device 20 as a different body, it may constitute as one.

[0041]

By this embodiment, the distance sensors 11 are installed in the case 10 3x2 so that it may correspond to the target point 5 arranged 3x2 as drawing 2 explained.

[0042]

case 10' shown in the mimetic diagram of drawing 4 although the distance sensors 11 are typically installed in the case 10 in parallel -- a curve may be attached to the case 10 like. In this case, the distance sensors 11 are installed so that this curve may be met. By using such case 10', even if it miniaturizes, the large monitor area 50 is easily securable. Since case 10' can perform installing the distance sensor 11 easily so that the ****** target point 5 may not lap even if it is small, it can attain the miniaturization of a device.

[0043]

Here, the distance sensors 11 are explained further. As the distance sensors 11 to be used, there are infrared irradiation type distance sensors, an ultrasonic sensor, an electro magnetic pulse distance sensor, a passive type optical distance sensor, etc. Among these, infrared irradiation type distance sensors, an ultrasonic sensor, and an electro magnetic pulse distance sensor are glared type sensors (active type distance sensor). As for the distance sensors 11 to be used, it is preferred to use what that is used for an auto-focus camera is comparatively simple and cheap as mentioned above. The monitoring instrument 1 can consist of using such a distance sensor 11 simply and cheaply. Hereafter, the infrared distance sensor as an example of the distance sensors 11, an ultrasonic sensor, an electro magnetic pulse distance sensor, and a passive type optical distance sensor are explained with reference to figures.

[0044]
With reference to the block diagram of drawing 5, the distance sensors 30 (henceforth the infrared distance sensor 30) infrared irradiation type [as an example of the distance sensors 11] are explained. The infrared distance sensor 30 is what is called an active type optical sensor. The infrared distance sensor 30 is constituted including the infrared light irradiation part 31 as a Mitsuteru gunner stage which irradiates the sleeping person 2 with light flux, the infrared light light sensing portion 32b, and the sensor control part 33 that controls the infrared distance sensor 30 whole. It may be made to have the sensor control part 33 in the control section 21 of the control device 20 (refer to drawing 3).
[0045]
The infrared light irradiation part 31 is equipped with infrared LED34 and the irradiation lens 35, and it is irradiated with the light flux of the infrared light irradiated from infrared LED34 by the sleeping person 2 as a beam of a thin parallel pencil via the irradiation lens 35. If substantially parallel to a parallel pencil, it is good and light flux near in parallel is also included here. The infrared light light sensing portion 32 is provided with the following.
The light-receiving lens 37 as an image formation optical system which carries out image formation of the image of the optical irradiation pattern generated by the infrared light irradiation part 31 on the sleeping person 2.
The one-dimensional position detecting element 36 (henceforth PSD36) as a light-receiving means to be arranged near the image formation position with the light-receiving lens 37, and to receive the image formation pattern light by the image of the optical irradiation pattern which carried out image formation.

[0046]
The infrared distance sensor 30 has the position information outputting part 39 as a position information output unit constituted so that the image formation position information on the image formation pattern corresponding to the distance to the sleeping person 2 might be outputted based on the image formation position of the image formation pattern light by which image formation is carried out on PSD36. It has the position information outputting part 39 in the sensor control part 33. That is, based on the image formation position of the image formation pattern light by which image formation is carried out with the light-receiving lens 37, it is constituted so that the image formation position information on the image formation pattern as an output corresponding to said distance may be acquired by trigonometry. Here, light flux is a beam and the optical irradiation pattern by light flux is a beam spot. And image formation pattern light is a light which enters into PSD36 among the catoptric light from the sleeping person 2 of the beam spot generated on the sleeping person 2, and an image formation pattern is an image of the beam spot generated on the sleeping person 2 by whom image formation was done with the light-receiving lens 37. That is, an image formation pattern is an image of an approximate circle form here.
[0047]
Coating which makes only the light of the wavelength band region of the beam irradiated with the light-receiving lens 37 penetrate is performed. Therefore, the influence of disturbance light can carry out a detecting position few. Although light flux was made into the thin parallel pencil above, this is just a parallel pencil substantially and may be the light flux diffused or converged to some extent. In this case, the size of the pattern light on the below-mentioned PSD36 should just be a grade which is suitable and by which the supplement of a centroid position is not hindered.
[0048]
The wavelength of the beam which the infrared light irradiation part 31 floodlights may be made for the infrared distance sensors 30 to differ for every sensor. In this case, it combines and is made for the transmitted wave length zone of coating performed to the above-mentioned light-receiving lens 37 to also turn into a transmitted wave length zone corresponding to the beam to floodlight. It is not

influenced by the beam of the next sensor, and even if it is a case where the ****** beam explained by drawing 2 (b) laps by this, since it is not necessary to control not to glare simultaneously, a monitoring instrument can be simplified. The infrared distance sensor 30 blinks infrared LED34 (light source) on fixed frequency, and it may be made to be provided with the electric band pass filter which extracts only the signal of the frequency to the infrared light light sensing portion 32. Thereby, the influence of disturbance light can be reduced. By changing this modulation frequency for every sensor, even when the beam explained by drawing 2 (b) laps, being influenced by the beam of the next sensor is lost. It is not necessary to control not to glare simultaneously by this, even if it is a case where a beam laps, and a monitoring instrument can be simplified. It is suitable even if it performs synchronous detection which makes it synchronize with the timing of an exposure of infrared LED34, and switches the polarity of the amplifier of the infrared light light sensing portion 32.

[0049]

With reference to drawing 6, PSD36 is explained further. Drawing 6 (a) is a schematic plan view, and drawing 6 (b) is a typical transverse-plane sectional view. As shown in drawing 6 (a), PSD36 has a larger acceptance surface product than an image formation pattern, and has the length which is a grade which is required ranging within the limits and an image formation pattern does not protrude in the move direction (left-in-the-figure right) of the image formation pattern by a distance change by movement of an image formation pattern.

[0050]

As shown in drawing 6 (b), PSD36 is constituted from the P layer 36a, the P layer 36a, and the I layer 36c that is in the middle of the N layer 36b, and the P layer 36a and the N layer 36b on the surface of an opposite hand by the surface of the side which receives the image formation pattern light of plate-like silicon. The image formation pattern by which image formation was carried out to PSD36 is changed into photoelectricity, and it is constituted so that a split output may be carried out, respectively from 36d of electrodes attached to the both ends of the P layer 36a as photoelectric current.

[0051]

Since the infrared distance sensor 30 outputs the centroid position of an image formation pattern as image formation position information on an image formation pattern by calculating the output signal of the photoelectric current outputted from the both ends of PSD36 by the position information outputting part 39, it can measure the distance to the sleeping person 2 like the after-mentioned. The infrared distance sensor 30 is using infrared rays, and human being does not catch sight of it and it does not give displeasure to the beam with which it irradiates.

[0052]

The sensor control part 33 of the infrared distance sensor 30 becomes irregular in order to distinguish from disturbance light, when PSD36 detects the centroid position of an image formation pattern. Abnormal conditions are the operation which is performed by repeating the luminescence (exposure) stop of a beam periodically, for example. In this case, the luminescence stop of a beam may carry out the luminescence stop of the light source, for example, and may be made to carry out a luminescence stop by rotating a gobo and a slit. It may be made for abnormal conditions to also change the output of a beam by the strength of disturbance light furthermore in addition to ****. And the sensor control part 33 computes the output value which deducted the output value of PSD36 when not irradiating with the beam from the output value of PSD36 when irradiating with the beam. The sensor control part 33 makes modulation operation the center-of-gravity supplementary signal (henceforth a ranging signal) which is the image formation position information on an image formation pattern about a multiple-times deed and its average output value, in order to secure reliability. The sensor control part 33 is outputted to the control device 20 by making into distance the ranging signal value x which is a value of a ranging signal.

[0053]

As shown in the mimetic diagram of drawing 7, the distance value A to the target sleeping person 2 is computable with a following formula using trigonometry based on this ranging signal value x.
$A = f\,xw/(x-b)$ ...... (1)
When the light-receiving lens 37 of the infrared light light sensing portion 32 is used as a single lens, f the focal distance of the lens and w, In other words, the distance (base length) between the optic axes of the irradiation lens 35 and the light-receiving lens 37 and b indicate the distance between PSD36, and the bias value depending on arrangement of the photo detector of PSD36 to be infrared LED34. When using the combination lens generally used, let a focal distance here be a focal distance of the combination lens. When computing the above distance values A, it is good to compute the distance value A by the control section 21 of the control device 20.
[0054]
Although the case where the ranging signal value x was outputted as a distance was explained, above, the infrared distance sensor 30 may be constituted so that the distance value A itself computed by the above-mentioned method as a distance may be outputted.
[0055]
The ranging signal value x outputted from each infrared distance sensor 30 is changed by the influence of disturbance light still remaining slightly, although it becomes irregular as mentioned above. In order to absorb this change, the ranging signal value x acquired serially is averaged, and it is considered as the data at that time. The average value of the distance value A computed from the ranging signal value x may be sufficient as this data, and the depth L2 which is the average value of the height H2 or the depth L1 which is average value of the height H1 computed from the distance value A explained later may be sufficient as it. Although it thinks [that it is various and], the method of defining a fixed time interval beforehand, and equalizing data in the meantime, defining the number to equalize beforehand, and computing a moving average deviation serially may be sufficient as how to take an average. In the case of the former, there are few data numbers, and it ends, and is suitable for rough state grasp. In the case of the latter, although some data numbers increase, they can follow a fine action.
[0056]
Thus, since the infrared distance sensor 30 can be simply constituted from using PSD36, it can be used as a cheap and simple monitoring instrument.
[0057]
With reference to the block diagram of drawing 8, the ultrasonic sensor 70 in an embodiment of the invention is explained. The ultrasonic sensor 70 is constituted including the ultrasonic transmission part 71 as an ultrasonic wave oscillator, the ultrasonic reception part 72 as an ultrasonic receiver, and the sensor control part 73. Furthermore in the sensor control part 73, it has the distance calculation section 74 which computes the distance to the sleeping person 2 by the time lag of transmission of the ultrasonic transmission part 71, and reception of the ultrasonic reception part 72. It may be made to have the sensor control part 73 in the control section 21 of the control device 20. Although the ultrasonic transmission part 71 and the ultrasonic reception part 72 considered it as the different body in this embodiment, they may be one. The distance to the sleeping person 2 computed by the distance calculation section 74 is good also as the time lag itself. This is because the distance to the sleeping person 2 is linearly found from a time lag, so change of a time lag can be regarded as change of distance as it is.
[0058]
A means to generate an ultrasonic wave in the ultrasonic transmission part 71 holds the material which has the piezo-electric effect, such as electrostrictive ceramics, with a metal plate etc. (vibrator), and by impressing a signal level, when a vibrator carries out flexing vibration, it generates an ultrasonic wave. A means to receive by the ultrasonic reception part 72 obtains electric generating power, when the reflected ultrasonic wave vibrates a vibrator. Therefore, in the case of an ultrasonic distance sensor, if an ultrasonic wave can be generated intermittently, the signal wave

which has reflected and returned can be detected and a time lag can be detected by the origination side and a receiver, since acoustic velocity is known, the distance to the sleeping person 2 can be measured. In this case, although based also on signal processing after detection, the nearest reflection can be detected or an average distance of an irradiation area can be measured.

[0059]

With reference to the block diagram of drawing 9, the electro magnetic pulse distance sensor 80 in an embodiment of the invention is explained. The electro magnetic pulse distance sensor 80 is constituted including the electromagnetic wave transmission and reception section 81 and the sensor control part 82. The electromagnetic wave transmission and reception section 81 is constituted including an antenna, and performs oscillation of electromagnetic waves by which pulse modulation was carried out towards the sleeping person 2, and reception of the electromagnetic waves reflected by the sleeping person 2. Furthermore in the sensor control part 82, it has the distance calculation section 83 which computes the distance to the sleeping person 2 by the time lag of the oscillation of electromagnetic waves, and reception. It may be made to have the sensor control part 82 in the control section 21 of the control device 20. Although the electromagnetic wave transmission and reception section 81 considered it as one in this embodiment, it may constitute an electro magnetic pulse transmission section and an electromagnetic wave receive section in a different body. The distance to the sleeping person 2 is good also as the time lag itself like the above-mentioned ultrasonic sensor 70. Electromagnetic waves are about 10-GHz microwave typically.

[0060]

Since directivity becomes strong rather than an ultrasonic wave by using microwave for electromagnetic waves, the electro magnetic pulse distance sensor 80 can measure the target point 5 at pinpoint more. Since it will measure distance from what has returned in shortest time among the reflected electromagnetic waves if the electro magnetic pulse distance sensor 80 has the reflection from the part irradiated by the subject, it does not cause incorrect ranging by the image formation beam on PSD being missing, for example like an infrared distance sensor. Even if the electro magnetic pulse distance sensor 80 has contrast (for example, striped pattern) strong in an irradiation area, it is not influenced like an infrared distance sensor. The electro magnetic pulse distance sensor 80 can be miniaturized easily.

The above infrared distance sensor 30, the ultrasonic sensor 70, and the electro magnetic pulse distance sensor 80 are glared type sensors.

[0061]

With reference to the block diagram of drawing 10, the passive type optical distance sensor 40 in an embodiment of the invention is explained. The passive type optical distance sensor 40 is constituted including the 1st light sensing portion 41 as an image formation device which receives the light from the sleeping person 2, the 2nd light sensing portion 42, and the sensor control part 43. To the 1st light sensing portion 41 and the 2nd light sensing portion 42, respectively The light-receiving lenses 44a and 44b, It has the 1st line CCD45 as one pair of image sensors, and the 2nd line CCD46, and image formation of the light from the sleeping person 2 is carried out to the 1st line CCD45 and the 2nd line CCD46 via the light-receiving lenses 44a and 44b, respectively. The light from the sleeping person 2 is catoptric light from the sleeping person 2 of the irradiation light currently typically irradiated by the sleeping person 2. In this case, irradiation light may be available light or may be artificial light.

[0062]

It may be made for the passive type optical distance sensor 40 to irradiate with the illumination light which has a specific intensity pattern to the monitor area 50 by an unillustrated illumination pattern light projection means, as shown in drawing 11. In this case, an illumination pattern avoids clear cyclic structures, in order that two or more below-mentioned correlation peak positions may come out. That is, it is good to use an aperiodic illumination pattern. An aperiodic illumination pattern is

good to consider it as two or more aperiodic luminescent spots, for example like drawing 11 (a). It may be made for a luminescent spot to change each size. It is good also as the aperiodic singular number or two or more slit light like drawing 11 (b). It may be made for slit light to change each width. In this case, slit light is good for the base line direction of the distance sensors 11 like a graphic display to make it become vertical about. By doing in this way, it can prevent the below-mentioned correlative processing becoming inaccurate, also when the passive type optical distance sensor 40 has the low contrast within the target point 5 or the subject within the target point 5 has periodical structures (for example, striped pattern etc.), and exact measurement is possible.

[0063]

In the sensor control part 43, it has the correlation output calculation part 48 as a correlation output calculation device which computes the correlation output value of each output value of the 1st line CCD45 and 2nd line CCD46. It may be made to have the sensor control part 43 in the control section 21 of the control device 20. In the sensor control part 43, it is still better to have the difference image formation part 47 as a difference image forming device which forms the difference image of the picture which shifted time and was acquired about each of the 1st line CCD45 and 2nd line CCD46. Thereby, the sensor control part 43 can extract the image of the sleeping person 2 with a motion from the picture acquired from the 1st line CCD45 and the 2nd line CCD46. Although two pictures for forming a difference image shift and acquire time, the sleeping person's 2 movement magnitude does not become large too much, and should just make time to shift the about time of the grade it can be considered mostly substantially that is homotopic, for example, 0.1 second. Or it is considered as one to 10 of a television cycle cycle (1 / 30 - 1/3). If such a difference image is taken, the image of the sleeping person 2 for whom a background is removed and who has a motion can be extracted. The case where a difference image is used is explained in more detail later.

[0064]

A correlation output value is a relative image formation position difference generated with the azimuth difference of the 1st line CCD45 and 2nd line CCD46, and is a value typically outputted by correlative processing with a pixel number here. The sensor control part 43 computes distance with this correlation output value, i.e., the azimuth difference of the 1st line CCD45 and 2nd line CCD46 to trigonometry. Correlative processing is processing which computes by shifting one of the pictures acquired from the 1st line CCD45 and the 2nd line CCD46, respectively until two pictures are mostly in agreement, the quantity, for example, pixel number, which were shifted. A judgment of coincidence is made by the whole signal intensity. Signals are [peak ****** and time] identical features, i.e., a correlation peak position. The correlative processing by difference image formation binary-izes the difference image obtained from the 1st line CCD45 and the 2nd line CCD46, respectively with a proper value, and extracts an area part with a motion by extracting the edge part. Then, correlative processing is performed only in an extraction region. That is, the sleeping person's 2 distance can be found from a correlation output value. The 1st line CCD45 and the 2nd line CCD46 can be divided into two or more fields, by [corresponding] performing correlative processing the whole field, there are many backgrounds and a certain portion and subject can also be classified about.

[0065]

The passive type optical distance sensor 40 is a thing of a type which is adopted as the auto-focus camera, and detects the light-and-darkness state (difference in contrast) of the sleeping person's 2 surface using one pair of line CCD typically. The pixel to which one pair of line CCD corresponds identifies either by correlative processing, and measures distance by trigonometry. Its field angle is as narrow as about 10 degrees [full width], and line CCD generally used in the passive type optical distance sensor 40 needs comparatively many sensors, in order to cover the target point 5, but since it is not a glared type sensor, even if it operates the output from two or more sensors simultaneously, it is satisfactory at all. Therefore, it can process at high speed. Since the relative

location on one pair of line CCD is compared as compared with the infrared distance sensor, there is also no influence by a beam being halfway missing, and there is an advantage which is stabilized and can acquire the distance of the target point 5.

[0066]

Here, the case where the difference image for clarifying distinction with the sleeping person 2 in the target point 5 and a background is used by the passive type optical distance sensor 40 is explained in detail.

[0067]

The picture which picturized the target point 5 is serially acquired from the 1st line CCD45 and the 2nd line CCD46 as an electric imaging signal. As for the picture acquired at time to differ from the 1st line CCD45 and the 2nd line CCD46, a difference image is formed of the difference image formation part 47 for every line CCD. A difference image is formed by the picture acquired in time to differ here in order to remove background parts from the acquired picture and to extract the sleeping person's 2 picture. By this, only the sleeping person 2 who moves will be extracted. A difference image is formed from the picture at the time of a short time, for example, 0.1 second, shifting. Since gaps of a picture are few, the sleeping person's 2 position hardly changes and it does not interfere with measurement of distance. However, a background is eliminated and can extract the sleeping person's 2 image.

[0068]

The difference image in which the sleeping person 2 was extracted can consider that the pixel whose grade which became ** from the dark from ** or dark by the sleeping person's 2 movement is comparatively big is the sleeping person's 2 boundary. And exact, it being stabilized and measuring can do distance which is the sleeping person 2 by performing correlative processing and measuring the sleeping person's 2 distance by trigonometry in the picture element region inside this boundary.

[0069]

Here, with reference to drawing 12, the calculating method of the distance A by the target point 5 which uses the passive type optical distance sensor 50 is explained. Here, when, as for w, the distance between line CCD (base length) and f use the light-receiving lens of line CCD as a single lens, the focal distance of the lens and d are the azimuth difference on the image formation face of line CCD. When using the combination lens generally used, let a focal distance here be a focal distance of the combination lens. Thereby, the distance A by the target point 5 is computable with a following formula.

$A = w \times f/d$ ...... (2)

[0070]

As mentioned above, even if it uses which above-mentioned distance sensors as the distance sensors 11 of the monitoring instrument 1, the sleeping person's 2 distance is acquirable. That is, the sleeping person's 2 distance can be measured.

[0071]

It returns to drawing 3 and the monitoring instrument 1 is explained further. The control device 20 is provided with the control section 21, and is controlling the monitoring instrument 1 whole. It is connected to the control section 21 and two or more distance sensors 11 are controlled. The storage parts store 24 is connected to the control section 21, and the data of the information etc. which were computed can be memorized. In the storage parts store 24, it has the distance information preserving part 25 which saves the distance outputted from the distance sensors 11 by a time series. In the distance information preserving part 25, it is good to save the reference distance which is the distance by the target point 5 when the sleeping person 2 does not exist on the bed 6. Reference distance is saved with the same gestalt as the distance outputted from the distance sensors 11. The distance saved serially at the distance information preserving part 25 here is just the distance at the time of the past at the surveillance time, for example, may be the distance before acquired by one top.

[0072]
Furthermore in the storage parts store 24, it has the breathing pattern preserving part 26 which saves the sleeping person's 2 normal breathing pattern and unusual breathing pattern. The drawing 14 reference is carried out and a normal breathing pattern and an unusual breathing pattern are explained later.
[0073]
The output unit 28 which outputs the result processed with the input device 27 which inputs the information for operating the monitoring instrument 1, and the monitoring instrument 1 is connected to the control section 21. The input device 27 is a touch panel, a keyboard, or a mouse, and the output units 28 are a display and a printer. It may be built although the input device 27 and the output unit 28 are illustrated in this figure as what carries out external to the control device 20. The input device 27 of the switch and the output unit 28 which can perform a start and release of surveillance, for example is good also as LED as an operation indicator, for example. If it does in this way, the monitoring instrument 1 can be constituted simply.
[0074]
The control section 21 is equipped with the interface 29 for communicating with the exterior. It is constituted so that it can report outside, when it is judged that a state with the dangerous sleeping person 2 has the interface 29, for example by the detection processing part 23 of the control section 21. A report is based on the strength of the light which includes a sound, a character, a sign, and interior illumination, for example, or vibration. The interface 29 is provided with the function connected to communication lines, such as a general telephone line, an ISDN circuit, a PHS circuit, or a cellular-phone circuit. The control section 21 is provided with a voice response function, and it may be made to notify with a sound that a sleeping person is in a dangerous state to a third party via the interface 29.
[0075]
In the control section 21, it has the alarm equipment 90 constituted so that it might operate, when abnormalities occurred in the monitoring instrument 1. It is good to constitute so that it may operate, when it is judged that the alarm equipment 90 is in a state with the dangerous sleeping person 2, for example by the detection processing part 23 (i.e., when abnormalities, such as a case where abnormalities occur in the sleeping person 2, and failure of the monitoring instrument 1, occur). Since it can respond promptly by doing in this way to the abnormalities caused in the sleeping person 2, reliability can be improved. The control device 20 is good to constitute via the interface 29, so that generating of abnormalities may be notified outside as mentioned above, when the alarm equipment 90 operates. Although the alarm equipment 90 is illustrated as external, it is good also as built-in in this figure.
[0076]
In the control section 21, it has the operation part 22 as an arithmetic unit which calculates the temporal change of the distance outputted from two or more distance sensors 11. The distance outputted from two or more distance sensors 11 is good also as the moving average deviation of the distance which carried out past fixed count acquisition, or was acquired within past fixed time, or period average rates. By doing in this way, the sudden noise by flicker of the daylight inserted from random noise or a window, etc. can be reduced, and incorrect judgment of the erroneous decision of a peak position and a zero cross position (intersection which numerals reverse) can be reduced.
[0077]
Calculating a temporal change is extracting the sleeping person's 2 shape change obtained by taking the difference of the distance acquired from the distance sensors 11, and the distance saved serially at the distance information preserving part 25 by acquiring distance from the distance sensors 11 with a certain time interval. This is extracting the sleeping person's 2 breathing, a body motion, and movement, for example. Thereby, the sleeping person's 2 extracted breathing forms a waveform pattern.

Drawing 13 is a figure showing the example of a waveform pattern.
[0078]
Furthermore in the control section 21, it has the detection processing part 23 as a detection processing device. The detection processing part 23 is constituted so that the sleeping person's 2 shape change may be detected based on the temporal change calculated by the operation part 22. That is, it is constituted so that the sleeping person's 2 breathing, a body motion, and movement may be detected. The detection processing part 23 may be constituted so that the sleeping person's 2 shape change may be detected based on the temporal change about one or more selected distance sensors 11 among two or more distance sensors 11.
[0079]
The detection processing part 23 is constituted so that the sleeping person's 2 condition may be judged based on both the cycle of the periodic change under detected shape change, and both [either or].
[0080]
Furthermore, by comparing the distance by the target point 5 with the reference distance saved at the distance information preserving part 25, the detection processing part 23 is constituted so that the sleeping person's 2 lying in bed may be detected. It may be made for the detection processing part 23 to choose the distance sensors 11 with the largest difference of the distance by the target point 5, and reference distance by this comparison. And it may be made to detect the sleeping person's 2 breathing, a body motion, and movement based on the temporal change about the selected distance sensors 11.
[0081]
After fixed time detection of the periodic change (the sleeping person's 2 breathing) under detected shape change is carried out, the detection processing part 23 may be constituted so that the sleeping person 2 may be in the monitor area 50, namely, may judge the sleeping person's 2 lying in bed. It may be made for the monitoring instrument 1 to start judgment of the sleeping person's 2 dangerous condition, on condition that the sleeping person's 2 lying in bed was judged. Fixed time is the time which is stabilized and can detect breathing, for example, is 30 to 90 seconds more preferably for 30 to 120 seconds.
[0082]
When the detection processing device 23 changes into the state where a periodic change is not detected and beyond fixed time can detect neither transitive change nor a periodic change after detecting the transitive change under detected shape change, It is good to constitute so that the supervisory object 2 might come out of the surveillance object field 50, namely, the sleeping person 2 may judge that bed leaving was carried out. Said fixed time is about 1 to 3 minutes, for example. For example, when the sleeping person 2 actually does bed leaving after detecting a body motion and movement, since it falls gradually, if it is looking only by variation, the value of a temporal change will have time to become a range which detects breathing, and will no longer be detected at all after that. For this reason, a judgment of bed leaving is made on the time of changing into the state where neither transitive change nor a periodic change is undetectable. However, since it means being in a quiet state after detecting a body motion or movement if breathing is detected before becoming such, if breathing, a body motion, and movement are lost after that, it must be judged that it is in a dangerous state.
[0083]
Based on the sleeping person's 2 detected continuous shape change, the detection processing device 23 may be constituted so that the cycle of a periodic change may be supervised. That is, based on breathing of the detected sleeping person 2, a body motion, and movement, the detection processing device 23 is constituted so that the cycle of breathing of the sleeping person 2 may be supervised. The detection processing part 23 is constituted so that the sleeping person's 2 shape change may be detected based on both the cycle of a periodic change, and both [either or]. The

detection processing device 23 may be constituted so that a breathing rate may be supervised from the cycle of breathing. Here, it shall be contained in the concept to which supervising a breathing rate also supervises a cycle.
[0084]
In order to detect the shape change of the sleeping person 2 by the detection processing part 23, there are some methods and a typical example is shown below.
[0085]
As the 1st method of detecting the sleeping person's 2 shape change first, out of two or more distance sensors 11, the temporal change in the latest past fixed time chooses the greatest distance sensors 11, and the sleeping person's 2 shape change is detected based on the temporal change corresponding to the selected distance sensors 11. In this case, the method of choosing the distance sensors 11 with the largest change of a temporal change among the past about several times of the sleeping person's 2 breathing cycles (from several seconds to about about ten seconds) is effective as a method of choosing the distance sensors 11. How, as for this, reflection of breathing of the sleeping person 2 reflected in the temporal change corresponding to each target point 5 by the position of the target point 5 corresponding to each of two or more distance sensors 11, a body motion, and movement is carried out differs. For this reason, it is because it is effective to choose the distance sensors 11 corresponding to the temporal change which is reflecting it exactly in order for the detection processing part 23 to detect a minute change like breathing.
[0086]
Although it may change by the distance sensors' 11 selected in this way striking the sleeping person's 2 body motion, for example, changing sides, and moving, In such a case, after being in a quiet state, in fixed time, the distance sensors 11 with the largest change of a temporal change are chosen again, and a periodic change, i.e., breathing, comes to be detected. In this case, one cycle of the detected signal will correspond to 1 breathing. Since change of a far larger temporal change than breathing is detected while the sleeping person 2 is moving, it turns out that the sleeping person 2 is in a body motion state. This fixed time is time suitable for choosing the distance sensors 11 with the largest change of a temporal change, and, in other words, it is time until it is reflected in a temporal change that the sleeping person 2 changed into the quiet state. If this evaluates only the amplitude of a periodic change, for example, it will be about 10 to 15 seconds more preferably several seconds (for example, 3 seconds) - about 20 seconds. If frequency analysis is conducted and a breathing rate is evaluated, it will be about 30 to 90 seconds. A quiet state is in the state where transitive change, i.e., a body motion, and movement are no longer detected. The state where transitive change is no longer detected so that it may explain in full detail by a 2nd embodiment, For example, if it judges that there was transitive change when a threshold was set up and a temporal change exceeded this threshold, and it is made to judge that it changed into the state where transitive change is no longer detected when less than this threshold and, it understands.
[0087]
A temporal change chooses the distance sensors beyond constant value, the periodic change of each selected temporal change is detected, and it may be made to evaluate the existence and the breathing rate of breathing from a periodic change with the clearest (breathing is expressed) periodicity.
[0088]
As the 2nd method of detecting the sleeping person's 2 shape change, the detection processing part 23 chooses two or more distance sensors 11 altogether, asks for total of the temporal change of the output of all selected these distance sensors 11, and detects the sleeping person's 2 shape change based on this total. Since this method detects the sleeping person's 2 shape change based on total of the temporal change of the distance outputted from all the distance sensors 11, it cannot be said to be not necessarily the most highly sensitive, but it is the simplest method and high speed processing can realize it easily. As total of the temporal change of distance, it is good

also as total of the difference of the distance outputted from the distance sensors 11, and reference distance. In this case, one cycle of the detected signal will correspond to 1 breathing.
[0089]
As the 3rd method of detecting the sleeping person's 2 shape change, the detection processing part 23 chooses the temporal change in which an absolute value exceeds constant value, and detects the sleeping person's 2 shape change based on the average value of the selected temporal change. Since this method detects the sleeping person's 2 shape change based on the average value of the temporal change of distance, it can prevent thinning the sleeping person's 2 partial large motion on the whole, becoming a size near the movement toward breathing, and influencing detection of breathing of the sleeping person 2. In this case, one cycle of the detected signal will correspond to 1 breathing.
[0090]
As the 4th method of detecting the sleeping person's 2 shape change, the detection processing part 23 chooses the temporal change in which an absolute value exceeds constant value, and detects the sleeping person's 2 shape change based on the average value of the absolute value of the selected temporal change. Since this method detects the sleeping person's 2 shape change based on the average value of the absolute value of the temporal change of distance, For example, since it is integrated without offsetting each even if multiple selection of the temporal change of the distance in which an absolute value exceeds constant value is made and the temporal change of two or more selected distance has positive/negative, sensitivity becomes good to a small change like breathing. In this case, two cycles of the detected signal will correspond to 1 breathing.
[0091]
As the 5th method of detecting the sleeping person's 2 shape change, each phase of the temporal change about two or more selected distance sensors 11 is compared mutually, a phase carries out grouping of the near things of each by this comparison, and the detection processing part 23 asks for total of each group's temporal change. And each group's total is ****(ed) among the groups near an opposite phase. The detection processing part 23 detects the sleeping person's 2 shape change based on the value obtained from this ****. Since each phase of a temporal change carries out grouping of the near things of each and this method asks for total, the sleeping person's 2 breathing is extracted as a group, and it can amplify it, for example. Since the sleeping person's 2 shape change is detected based on the value which ****(ed) each group's total and was obtained from **** among the groups still nearer to an opposite phase, For example, by the sleeping person's 2 breathing, even if there are a portion which goes up, and a falling portion, by ****(ing), breathing pattern amplitude can be made to be able to amplify and breathing can be detected certainly. In this case, one cycle of the detected signal will correspond to 1 breathing.
[0092]
As the 6th method of detecting the sleeping person's 2 shape change, The detection processing device 23 computes the frequency spectrum of all the outputs of two or more distance sensors 11, The sharpness of the peak of said computed frequency spectrum is beyond constant value, and said sharpness may choose the highest distance sensors 11, and based on the temporal change about said selected distance sensors 11, it may constitute so that the shape change of the supervisory object 2 may be detected.
[0093]
The value which did division of the height of a spectral peak with the integral value of the height of the spectrum of a perimeter wave number, and when discrete, the sharpness (acutance of image of a peak) of a peak, for example, For example, the value which did further division of the value which added height with the higher spectrum of the next door of a peak to the peak height by the sum of the height of the spectrum of a perimeter wave number can be made into an index. Since the distance sensors 11 which have detected the sleeping person's 2 breathing clearly can be chosen by evaluating that the sharpness of a peak is beyond constant value, it is easy to detect the sleeping

person's 2 breathing.
[0094]
As the 7th method of detecting the sleeping person's 2 shape change, The detection processing device 23 computes the frequency spectrum of the output of the distance sensors 11 which have an absolute value of said temporal change in predetermined width, It is good for the sharpness of the peak of said computed frequency spectrum to be beyond constant value, and for said sharpness to choose the highest distance sensors 11, and to constitute based on the temporal change about said selected distance sensors 11, so that the shape change of the supervisory object 2 may be detected. In this method, it becomes easy to detect the sleeping person's 2 breathing to set width predetermined in the absolute value of a temporal change as the field to which the sleeping person's 2 breathing exists.
[0095]
As the 8th method of detecting the sleeping person's 2 shape change, The detection processing device 23 computes the frequency spectrum of the output of two or more distance sensors 11 from the one where the absolute value of said temporal change is larger, It is good for the sharpness of the peak of said computed frequency spectrum to be beyond constant value, and for said sharpness to choose the highest distance sensors 11, and to constitute based on the temporal change about said selected distance sensors 11, so that the shape change of the supervisory object 2 may be detected.
[0096]
The detection processing part 23 detects the sleeping person's 2 shape change using the above detecting methods. The monitoring instrument 1 judges the sleeping person's 2 condition based on the detected shape change. For example, when the cycle which a breathing pattern has for a short time is confused, or when the cycle which a breathing pattern has changes rapidly, it can be surmised that they are cerebrovascular disease, such as heart diseases, such as lung diseases, such as spontaneous pneumothorax and bronchial asthma, and congestive heart failure, or cerebral hemorrhage, for example. When disappearance of a breathing pattern continues, it can be surmised that the sleeping person's 2 breathing stopped. And when the body motion of the sleeping person 2 instead of a breathing pattern occurs frequently for a short time, a situation in which the sleeping person 2 is troubled with a certain reason, and is rioting can be guessed.
[0097]
Since it changes sharply far compared with the case where only breathing is detected from a temporal change, detection of the sleeping person's 2 body motion or movement is easily detectable. In this case, the detection processing part 23 can also detect further whether the sleeping person 2 is moving rising whether it is moving by the spots, such as changing sides, for example, for example from a bed etc. from each temporal change corresponding to two or more distance sensors 11. Even when the sleeping person 2 does a periodic and small motion like a convulsion, abnormalities can be detected from the waveform pattern. It is also detectable with the state where the sleeping person 2 is twitching, by saving the waveform pattern in the state where it is twitching at the storage parts store 24.
[0098]
With reference to drawing 14, the example of a normal and unusual breathing pattern is explained. The normal breathing pattern saved at the breathing pattern preserving part 26 in the storage parts store 24 is a periodic pattern as shown in drawing 14 (a). However, the range normal as a breathing rate for 1 minute in the case of an adult is about 10 to 20 times. The unusual breathing pattern saved at the breathing pattern preserving part 26, For example, it is the breathing pattern considered to produce chain stokes (Cheyne-Stokes) breathing, central hyperventilation, ataxic breathing, large breathing of dregs MAURU (Kussmul), etc. when the obstacle has occurred inside of the body physiologically.
[0099]

The breathing pattern of central hyperventilation is shown in drawing 14 (c), and the breathing pattern of ataxic breathing is shown for the breathing pattern of Cheyne-Stokes breathing in drawing 14 (b) at drawing 14 (d), respectively.
Furthermore, the name of a disease or the disease part at the time of being generated by the above-mentioned unusual breathing pattern is shown in drawing 15.
[0100]
The detection processing part 23 distinguishes whether the sleeping person's 2 breathing pattern belongs to which breathing pattern using the frequency of breathing of each breathing pattern and appearance frequency differing from sounding, and judges the sleeping person's 2 condition.
[0101]
Furthermore, when it judges with belonging to the breathing pattern considered that the sleeping person's 2 breathing produces the detection processing part 23 in **** which the obstacle has generated inside of the body physiologically, if the sleeping person 2 is doing unusual breathing and is in a dangerous state, it will detect. The sleeping person's 2 condition detected in this way is outputted by the control section 21 from the output unit 28. The contents outputted are the name of a disease, a disease organ, a disease part, etc. which are considered when it comes to the sleeping person's 2 detected breathing rate, the frequency of a motion, and the name of an unusual breathing pattern and the cause of the breathing.
[0102]
Above, in two or more case, it explained, but the number of the distance sensors 11 may be one, and in that case, they can simplify the monitoring instrument 1 and can miniaturize it. Since the number of the outputs from the distance sensors 11 to process decreases, the high speed processing of the monitoring instrument 1 is possible.
[0103]
According to a 1st above embodiment, the sleeping person's 2 breathing can be detected certainly and the sleeping person's 2 condition can be judged. And since image processing using the camera which is mentally uncomfortable is not used, high speed processing is possible with a simple device. When elderly people and a sick person fall into critical condition, a prompt emergency action is possible.
[0104]

[Translation done.]

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1]It is a typical perspective view showing the outline of the monitoring instrument which is an embodiment of the invention.
[Drawing 2]It is a schematic plan view explaining the example of arrangement (b) with which the example of arrangement of the target point which is an embodiment of the invention (a), and a target point overlap.
[Drawing 3]It is a block diagram showing the example of composition of the monitoring instrument used by an embodiment of the invention.
[Drawing 4]It is a typical side view explaining the case where attach a curve and the distance sensors which are embodiments of the invention are installed.
[Drawing 5]It is a block diagram showing the example of composition of the infrared distance sensor used by an embodiment of the invention.
[Drawing 6]They are the (a) schematic plan view explaining PSD in the case of drawing 5, and (b) typical transverse-plane sectional view.
[Drawing 7]It is a mimetic diagram which illustrates how to compute the distance of a supervisory object by an embodiment of the invention.
[Drawing 8]It is a block diagram showing the example of composition of the ultrasonic sensor used by an embodiment of the invention.
[Drawing 9]It is a block diagram showing the example of composition of the electro magnetic pulse distance sensor used by an embodiment of the invention.
[Drawing 10]It is a block diagram showing the example of composition of the passive type optical distance sensor used by an embodiment of the invention.
[Drawing 11]It is a schematic diagram showing the illumination pattern in the case of drawing 10.
[Drawing 12]It is a mimetic diagram which illustrates how to compute the distance of a supervisory object from the azimuth difference of one pair of line CCD in the case of drawing 10.
[Drawing 13]It is a schematic diagram which is used by an embodiment of the invention and in which showing the waveform pattern of breathing.
[Drawing 14]It is a schematic diagram showing the waveform pattern of normal and unusual breathing in the case of drawing 13.
[Drawing 15]It is a figure showing the table of the name of a disease corresponding to the waveform pattern of unusual breathing in the case of drawing 14, or a disease part.
[Description of Notations]
1 Monitoring instrument
2 Sleeping person
3 Bedding
4 Stand
5 Target point

6 Bed
10 Case
11 Distance sensors
20 Control device
21 Control section
22 Operation part
23 Detection processing part
24 Storage parts store
25 Distance information preserving part
26 Breathing pattern preserving part
27 Input device
28 Output unit
29 Interface
30 Infrared distance sensor
31 Infrared light irradiation part
32 Infrared light light sensing portion
40 Passive type optical distance sensor
41 The 1st light sensing portion
42 The 2nd light sensing portion
47 Difference image formation part
48 Correlation output calculation part
50 Monitor area
70 Ultrasonic sensor
80 Electro magnetic pulse distance sensor

[Translation done.]

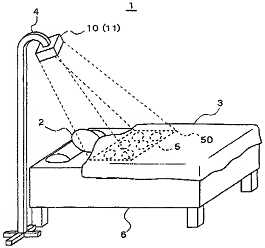
* NOTICES *

JPO and INPIT are not responsible for any
damages caused by the use of this translation.

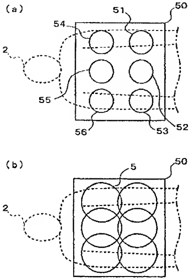
1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DRAWINGS

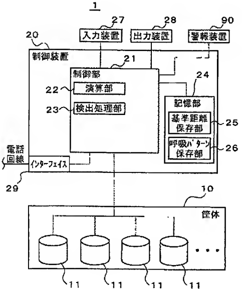
[Drawing 1]



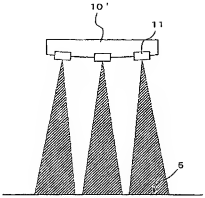
[Drawing 2]



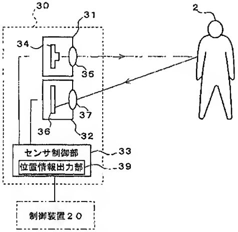
[Drawing 3]



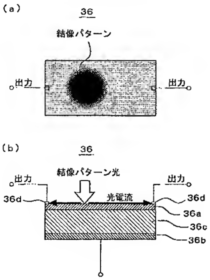
[Drawing 4]



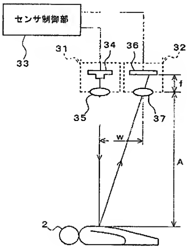
[Drawing 5]



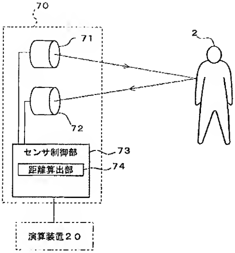
[Drawing 6]



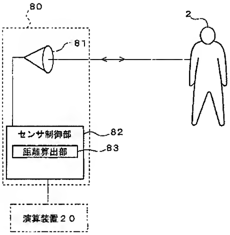
[Drawing 7]



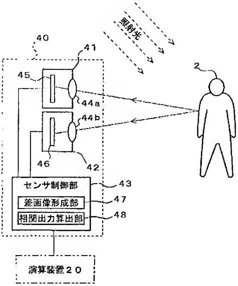
[Drawing 8]



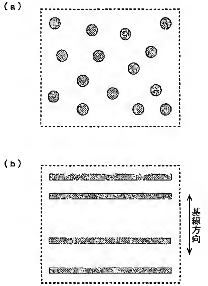
[Drawing 9]



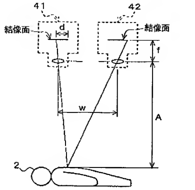
[Drawing 10]



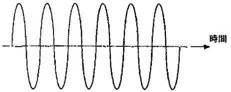
[Drawing 11]



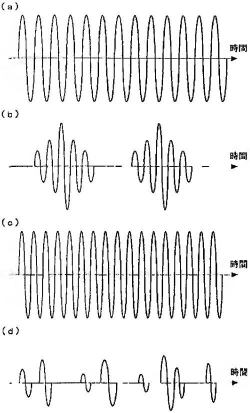
[Drawing 12]



[Drawing 13]



[Drawing 14]



[Drawing 15]

Cheyne-Stokes 呼吸	両側大脳皮質下および間脳の障害
中枢性過換気	中脳下部から橋上部の障害
失調性呼吸	橋下部から延髄上部の障害
Kussmaul の大呼吸	糖尿病性昏睡または尿毒症

[Translation done.]